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Wave Motor Experiments

Theatre Switchboards

The JOURNAL OF ELECTRICITY

AN ILLUSTRATED REVIEW OF THE INDUSTRIAL APPLICATIONS OF ELECTRICITY, GAS AND POWER.

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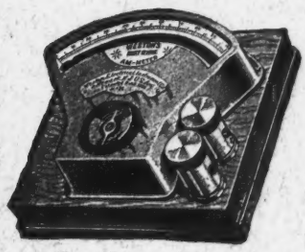

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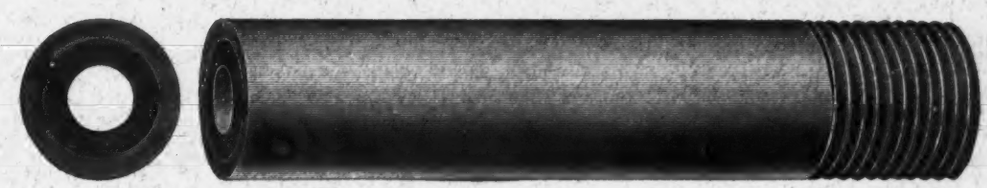

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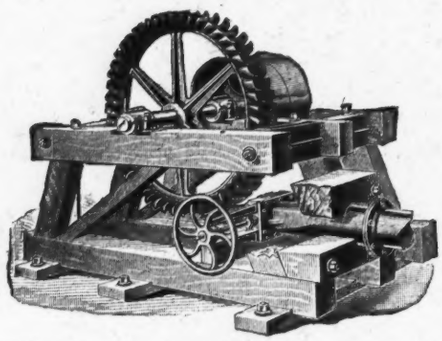

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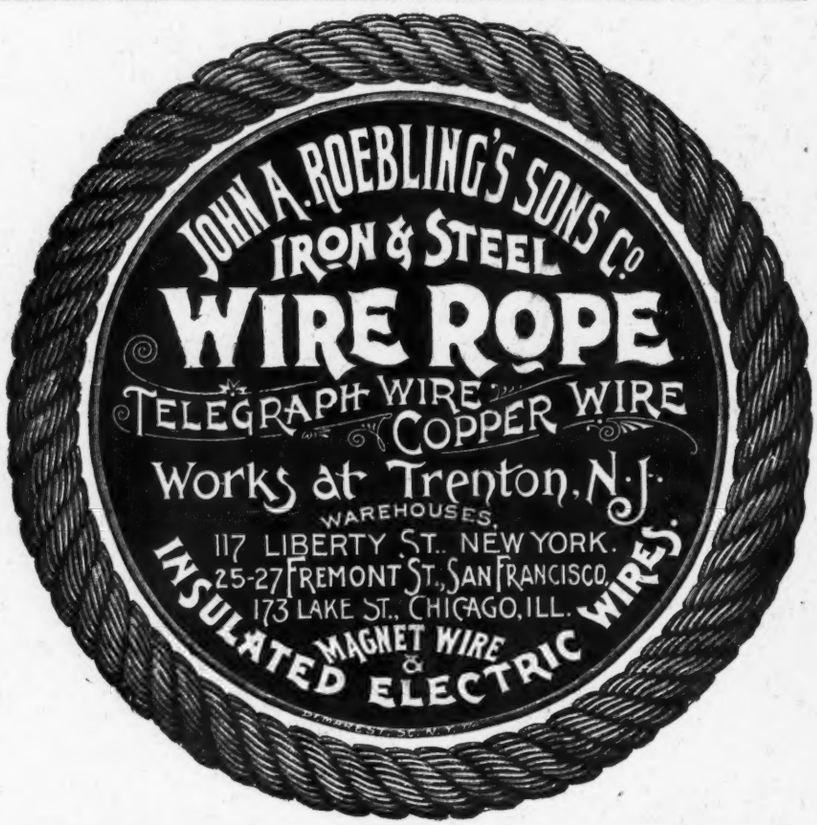

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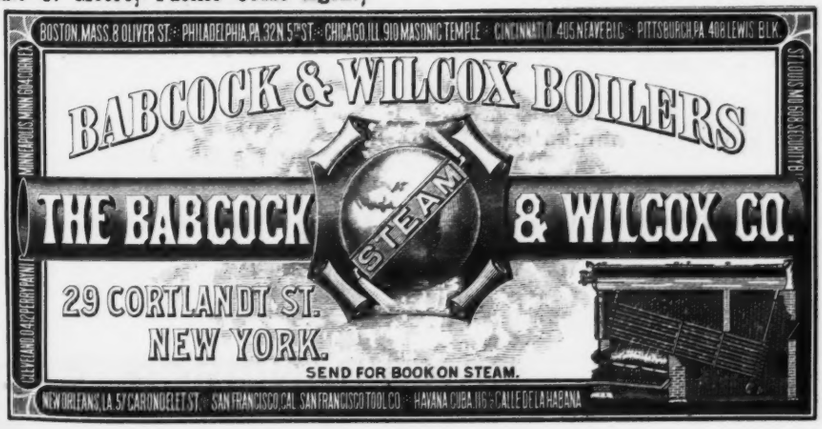
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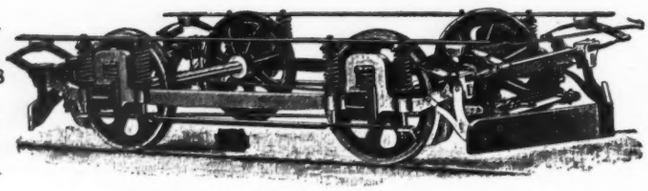

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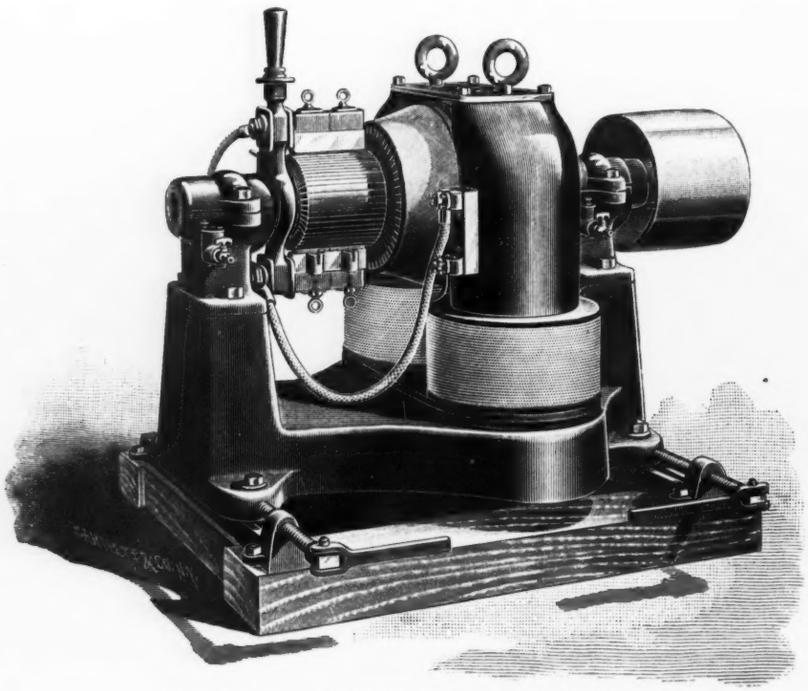

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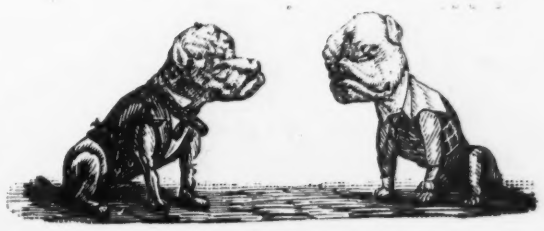

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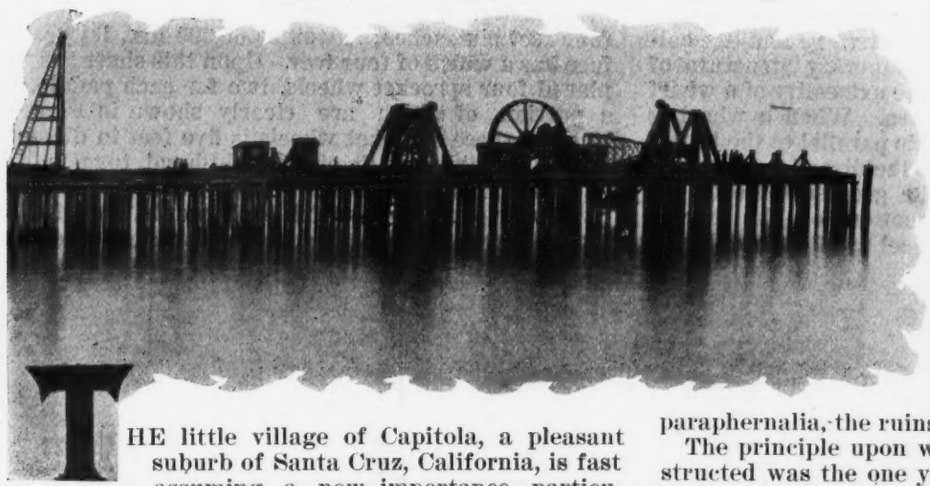
VOL. II. JANUARY, 1896. NO. 1

Wave Motor Experiments



THE little village of Capitola, a pleasant suburb of Santa Cruz, California, is fast assuming a new importance, particularly in the mechanical engineering world, because of the series of experiments that are now about to be carried out there, and in which the promoters believe will contain the results of all the experiences hitherto derived regarding the utilization of the energy of the waves of the ocean in the development of power. Almost from the earliest appreciation of the value of power the mind of man has been captivated with the possibilities of wave motors, but the fact of the commercially successful utilization of such prime movers is yet to be recorded.

On the Pacific Coast several rather extensive experiments have been made, two of which, in San Francisco, gave naught but discouragement in repay for the efforts and money which their promoters expended. Both of these experiments were carried out on the rocks beyond the Cliff House, and one of the wrecks remaining, and shown in Figure 1, exists as a monument to the fond but delusive hopes of the inventors. The first experiment at the Cliff House was that of the Steen wave motor (Figure 1). The rocks at the point of its location form a sort of cave, where the breakers rush in and out, sometimes with tremendous fury. Over the entrance of this cave a bridge was constructed, from which depended a huge paddle that was designed to swing, pendulum-like, back and forth in the waves. From its lower extremity a pitman was carried back toward the cave to the piston of a pump, sixty-five feet distant, the idea being that the latter could be operated from the stroke of the paddle. The timbers of the mechanism were of great strength, but not sufficiently so to withstand the beating of the waves, with the result that first the pitman was demolished and then the main timbers of the paddle gave away, and with it the perseverance of the inventor succumbed, as the wreck now standing evidences. It was designed that the pump should force water from the ocean to the top of the hill, at an elevation of between three and four hundred feet, and the pumping plant was put in with this intention, but the first rush constituting the maximum power of each wave, imparted such a blow to the pumping equipment as to not only prove the weakness of the machinery installed, but also to demonstrate the fact that something was radically wrong with the design of the apparatus.

The next effort at the Cliff House, and which constitutes the last endeavor there made towards the utilization of wave power, resulted in the building of elaborate paraphernalia, the ruins of which still exist.

The principle upon which this apparatus was constructed was the one yet predominating in the minds of inventors, namely, that the energy of waves may best be made available by the rise and fall of floats, but although the conditions were favorable for the test, and an expensive plant was put in, the inventor's hopes were not realized and the explosion of the dynamite-ladened schooner "Parallel" off the Cliff House

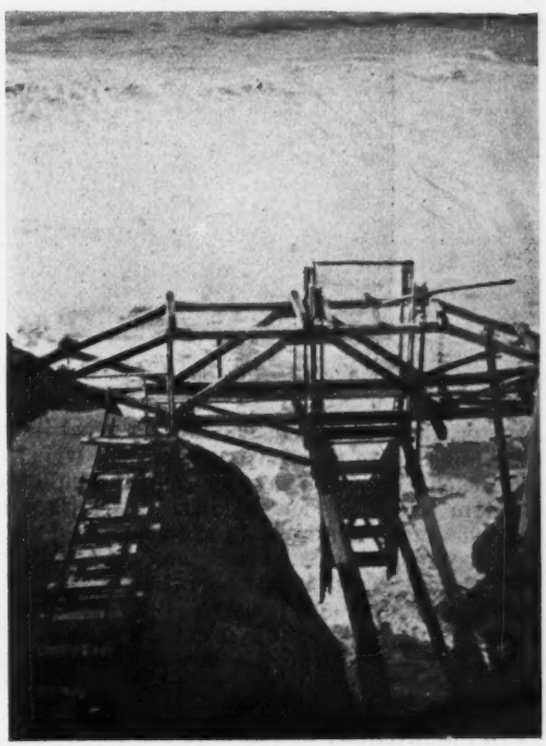


FIGURE 1—*A Wrecked Wave Motor.*

rocks seven years or so ago, wrecked the outfit, and afforded a fitting pretext for its abandonment. In this, as in the Steen motor, the ambition was to operate pumps for forcing water to the hill top, but if reports

be true, it was found that the capacity of the apparatus was limited by the weight of the float, which, together with the rise and fall and the time factor, was insufficient to develop material power. The Gerlach water motor, which is now under test at Capitola, exceeds all previous experiments on the Pacific Coast in point of magnitude and cost. Its general form, which is shown in the illustration at the heading of this article, is in particular a development of an experiment made at Long Beach, Cal., about two years ago. In this experiment a paddle wheel thirty-six feet in diameter, and having paddles six feet wide by three and one-half feet deep, was erected on a temporary structure of eight piles that were driven at the extremity of a wharf extending 1,100 feet into the sea. When a wheel is suspended in the rollers with axis parallel to the beach, the wheel will tend to rotate in the direction of rolling from the shore, because of the greater force of the inward than the outward motion of the waves. Although the action of the wheel is of an oscillatory character, there is thus a tendency to effect its revolution, which led to the construction of a wheel in the Long Beach experiment, rather than the building of a pendulum like vanes or paddles. The power of the wheel was made available by a rope passed about its circumference, which was connected to a pulley fitted with differentiating pawls and ratchets, so as to give the driven shaft continuous rotation, and under test the apparatus lifted a weight of 8,500 lbs. to a height of eighty feet in thirty seconds, representing a theoretical energy of a trifle over twenty-two horse power.

The results obtained at Long Beach were satisfactory to the inventor, who at once set about the organization of a company to prosecute experiments on a larger scale, and the fruits of his labors are represented in the Capitola experiments. A wharf extending into the sea a distance of 750 feet has been leased for twenty years, and upon the end of the pier has been extended 200 feet of very stable wharfing, upon which has been erected the plant shown in the accompanying illustrations. The general scheme of the Gerlach wave motor will be understood from a study of the first illustration. Two sets of vanes or paddle wheels swing with the surges of the waves, and from the extremities of each, chains fit to sprocket wheels, equipped with the differentiating gear, to be described, and by means of which rotation is imparted to the shaft carrying the large fly wheel shown. In detail, this main shaft is thirty feet in length and eight inches in diameter. The fly wheel has a diameter of twenty-four feet six inches; it weighs 60,000 lbs., its grooved face has a width of four feet. Upon this shaft has been placed four sprocket wheels, two for each paddle, and a portion of which are clearly shown in Figure 2. Each of these sprocket wheels is five feet in diameter, and is provided with eight right-hand toggles, two- and one-half by six inches in size, which act as pawls. By running two chains from each paddle, one of which chains is connected direct to its sprocket wheel and the other being carried over an idler wheel before being secured to the sprocket wheel, the same direction of pull is given to the shaft for either stroke or swing of the paddle. The paddles are each mounted upon a shaft eight inches in diameter and fifteen and one-half feet long, and are so equipped as to have a range of lift of thirteen feet in order that they may be kept at the most advantageous depth of immersion at all tides. The paddles are raised and lowered by screws in the pillars, which are actuated through worm gearing by means of power applied to the sheaves shown from the small sheaves on the main shaft. The paddles are of a uniform width of twelve feet, and are nine feet deep, hence there being three paddles to each equipment, there are 324 square feet of surface to each mechanism, or a total of 648 feet of paddle surface. The paddles weigh eight tons each, and swing with a radius of thirty-two feet, describing an arc, the maximum chord of which is twelve feet, while the average

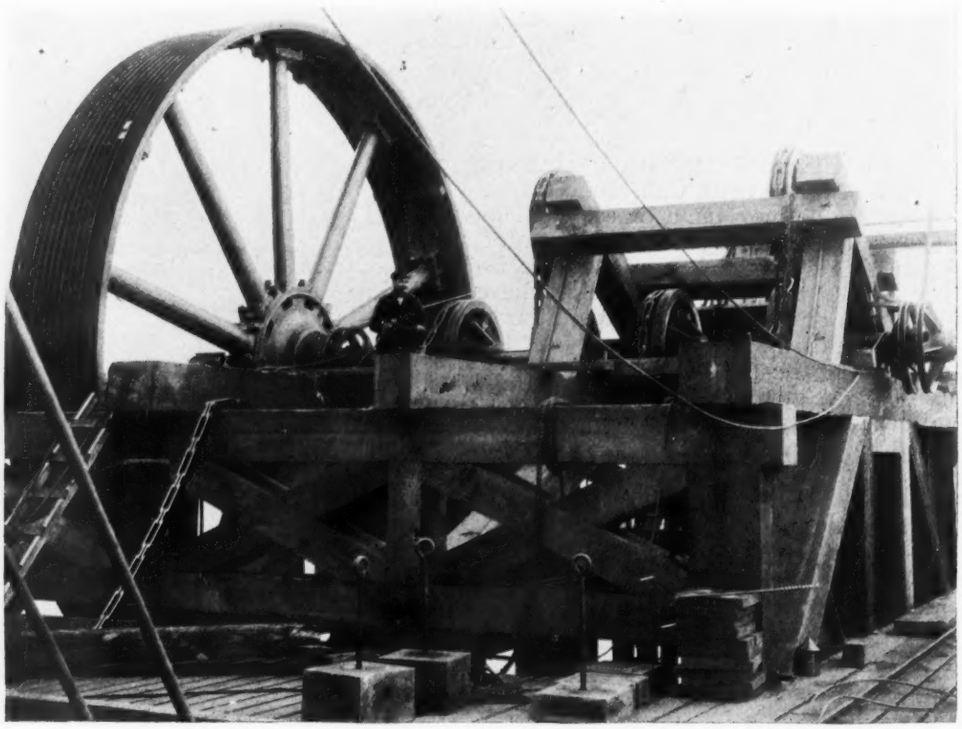


FIGURE 2—*Main Shaft of the Gerlach Wave Motor, showing the Sprocket Wheels and Toggle Grips.*

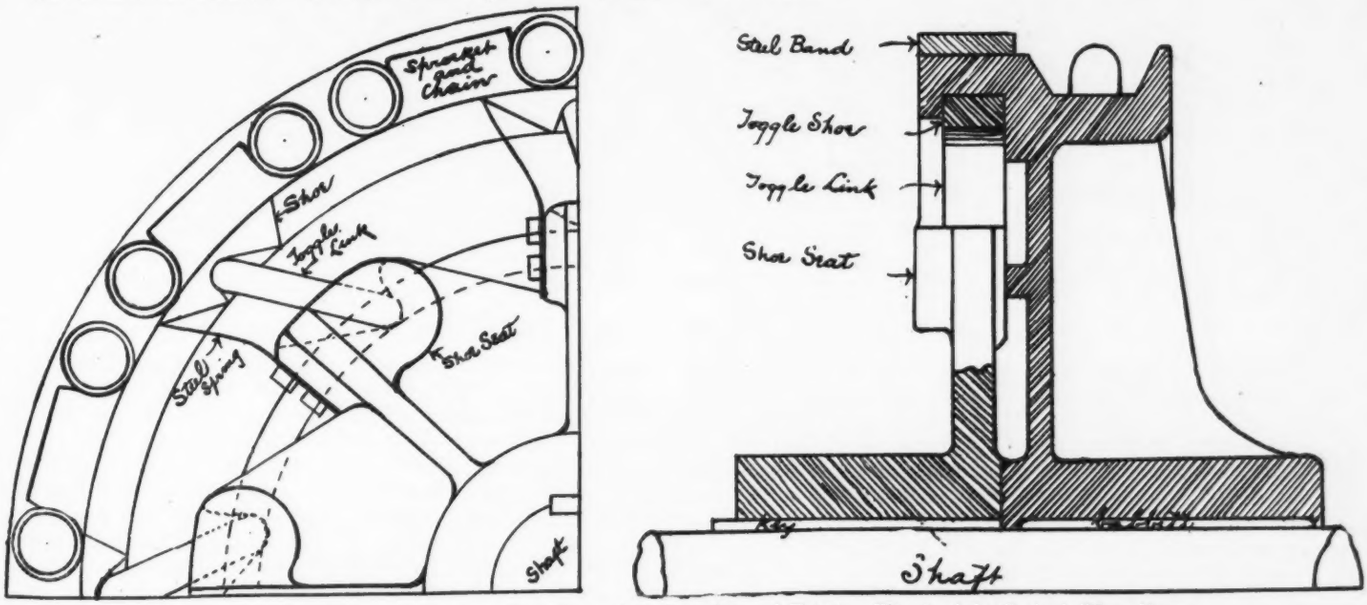
chord ranges between seven and eight feet. The swing occurs eight times per minute, thus giving thirty-two pulls per minute to the main shaft from the two paddles.

FIGURE 3—*Paddle Suspension of the Gerlach Wave Motor.*

A vital feature of the mechanism will be understood by reference to Figures 4 and 5, showing the arrangement of sprocket wheels on the main shaft and by means of which it will be remembered the main fly wheel is to be rotated. As shown in Figure 5 in detail the sprocket wheel proper really forms an idler that were it not for the toggle links, would revolve freely in either direction. Abutting this is the eight arm spider shown in Figure 5, which is rigidly keyed to the shaft. Referring again to Figure 5 it will be seen that an extension of the flange of the sprocket wheel is made to over-reach aportion of the spider wheel. The under side of the flange is grooved to confine within it the steel toggle shoe shown in elevation in Figure 5 and in section in Figure 4. This shoe is of peculiar formation and is held in place first by the tggle link shown and second by the constant pressure of a steel spring, the tendency of which is to cause slippage when the idler is run in a left hand direction. When the direction of revolution of the idler changes however, the toggle shoe grips with it as in a ratchet and pawl motion, and the shaft rotates. The drawing is at the scale of 1½ inches to the foot.

On January 9th the first and only effort was made to test the machinery, when it was found that the toggle pawls in the sprocket wheels on the main shaft were not properly proportioned and did not grip, and thus, instead of producing the desired friction, the sprocket wheels slipped without turning the main shaft. The motion imparted to the sprocket wheels by the paddle chains was satisfactorily regular, but in order to satisfy those present as far as possible, one of the steel toggles was made to fit temporarily, when the main shaft began to revolve at a considerable speed, thus demonstrating the practicability of the idea. The trouble with the toggle pawls constitutes a minor defect, which is now being remedied by the Atlas Iron Works of San Francisco, the contractors for the plant, and it is promised that the machinery will be in proper working order early in February, when it will be fully tested and the results published. The inventor expects that at least 200 horse power will be developed, which it is proposed to utilize by compressed air.

"We must congratulate you upon the general get-up and amount of good reading matter the 'Journal of Electricity' contains, and we consider it as good as any of the other American electrical periodicals," writes one of the leading publication houses of London and New York.



FIGURES 4 and 5—*Side and Sectional Elevations of the Sprocket and Friction Wheels of the Gerlach Wave Motor.*

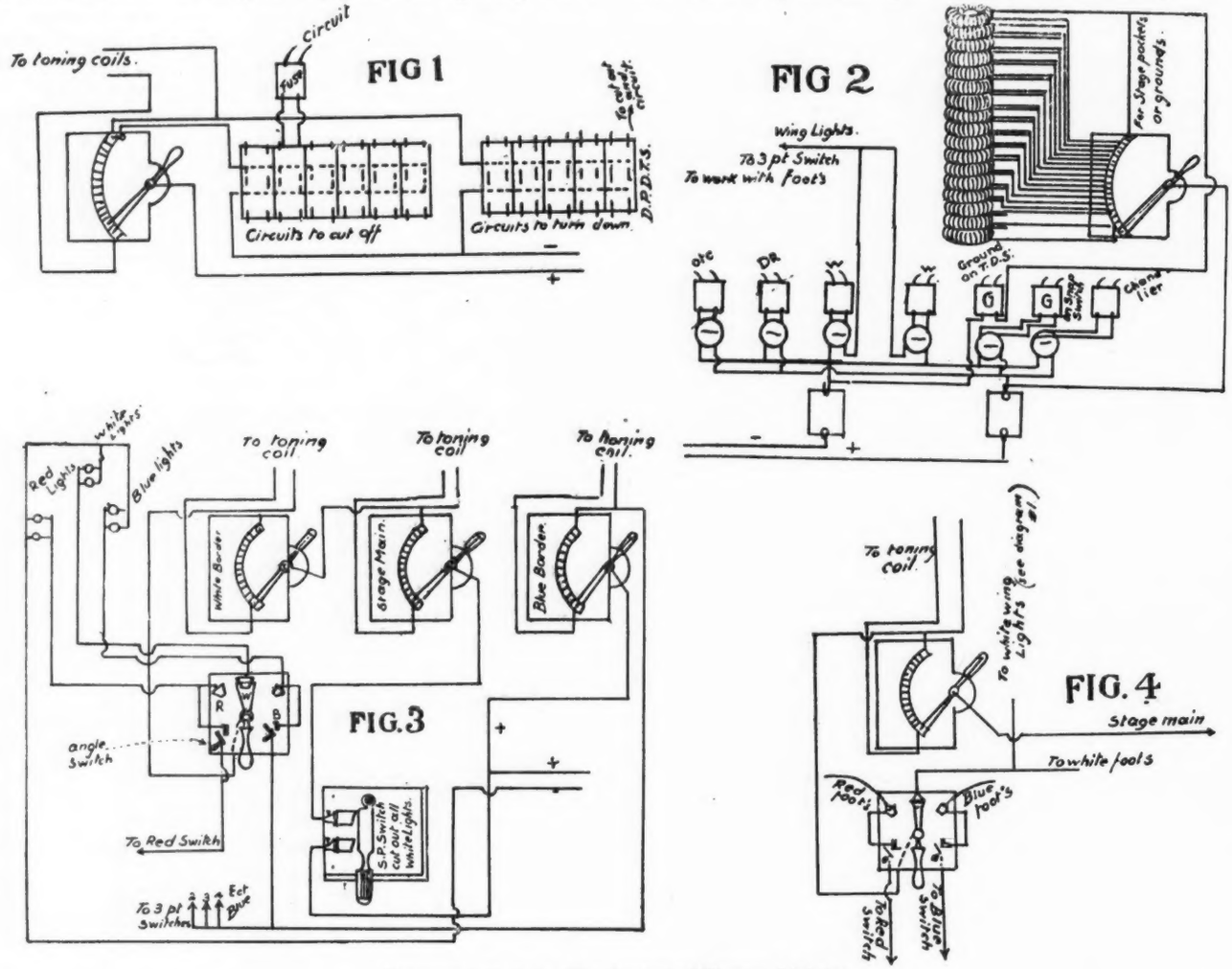
In the Journal of Electricity, San Francisco has one of the most creditable industrial publications issued on the Coast. Its gain is steady and rapid.—The Book and News Dealer.

THE CONTROL OF THEATER LIGHTING.

A switchboard for the control of the incandescent electric lighting of theaters must embody the following requirements: (1) It must be confined to a small space in order that every portion of it can be under the instant control of the switchboard operator. (2) It must be of the greatest possible simplicity in operation, in order that the greatest number of changes may be made with the least effort or number of motions. (3) Its equipment must be such as will effect the greatest possible economy in the use, control and dimning of lights. (4) Its design must effect many switching combinations so as to give any possible lighting effect required—a difficult requirement when it is remembered that moonlight, sunrise and sunset effects, together with other changes requiring perfect graduations and manipulations of light such as tableaux, dark changes, lightning, etc., must be carried out. The contractor must have a full appreciation of the art of blending colored and white lights, and above all, his experience in electrical installation must be of the very highest order to secure the most important features of permanence and absolute reliability of workmanship.

There is no doubt that alternating currents constitute the ideal means for theater lighting, not only by reason of its flexibility in conversion, but because of the fact that in the use of toning or choke coils is effected a most satisfactory means for dispensing with the use of resistances, which constitutes a means of control that is wasteful of energy, hence very expensive. It is with a view of describing a modern theater installation operated on alternating circuit, that the accompanying drawings and illustrations are given. The subject chosen is the Macdonough Theater of Oakland, Cal., which is believed to be one of the most perfect equipments of the kind on the Pacific Coast, if not in the country. The switchboard in question is shown in Figure 5.

The reaction or toning coils constitute the only piece of apparatus used which is not of a familiar type, and these differ radically from ordinary toning coils in that each step of toning is accomplished throught the



FIGURES 1, 2, 3, 4—*The Control of Theatre Lighting.*

cutting in or out a single choke coil. It was found by experiment to be desirable that there should be a range of seventeen steps in the toning of the lights, to accomplish which, each toning switch contains seventeen toning coils, which are generally coupled in a series in the main current and commutated by the toning switch, as clearly shown in Figure 2. There is, therefore, no movable secondary coil or core, but each of the coils used is a single reaction coil of ring type, wound with a single length of wire, varying in size according to the current carried on the circuit. The core of the coils consists of a length of seventeen feet of soft iron baling band, less than 1-32 of an inch in thickness by about $\frac{5}{8}$ of an inch in width, which is rolled into a ring having an inside clearance about five inches. The different convolutions of the iron

band may be insulated magnetically from each other by rusting or by paper, the latter being used in the present instance, and after the ring is finished, it is taped and dipped into plaster of Paris several times until it is entirely encased by the plaster to a depth of about ¼ of an inch. After having been thoroughly dried out the plastered ring is again taped and wound with wire as necessary, which finishes the coil. This form has been adopted after long experiment as best satisfying the conditions, and it is found that the use of plaster of Paris proves most effectual in deadening the hum of alternating current apparatus, as only by the closest listening at the choke coils can any hum be detected.

In Figure 1 may be found the detail of the auditorium or front-of-house switches, which shows the combination for changing to duplicate circuits or allowing any circuit to be cut out completely or to throw any circuit on to the turning down switch. All switches used are of the double pole, double throw type, the house circuits being connected with the fulcrum of the switches. The main toning switch is connected in series with the choke coils as shown in Figure 1

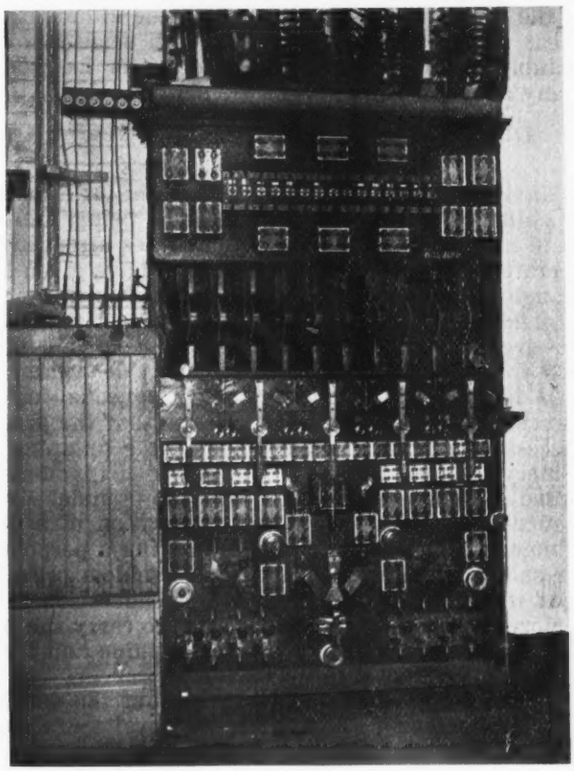


FIGURE 5—*The Macdonough Theatre Switchboard*

(the detail of the toning coil switch being as in Figure 2), and to dim any or all circuits, it is only necessary to throw the switch to its lower "turn down" position, while the throwing of the switch to the upper portion cuts out the toning switch from the circuit, thus burning the house lights to full brilliancy.

As previously described, Figure 2 shows the connections of the special choke coils, and in addition shows the arrangement of snap switches and fuse blocks for dressing rooms, stage chandeliers, wing lights, ground or stage lights, etc. Wing lights are ordinarily used in connection with the main footlight switch outlined in Figure 4. The sketch shows in particular the combination of foot and wing lights. One side of each circuit is taken from the snap switches in Figure 2 and carried to the three point switch in Figure 4, thus enabling the potential of the circuits to be turned down with the foot lights, or cut out, as desired. The colored wing lights are operated in a similar manner, except that they are connected to the red and blue points of the three point switches only. This three point switch is really a main switch, and is ordinarily termed the ground switch, because it controls the lights that are used on the stage floor, such as bunch lights, piano lamps, and lights that are used in places where the foot or border lights might cast undesirable shadows. The term "ground," therefore, is thus used in a theatrical and not in an electrical sense, and from the ground switch, circuits are carried to pockets or receptacles cut into the stage for attaching floor plugs, etc. Four of these pockets are connected to the turn down switch, and two are connected to the map switches marked G, thus allowing some to be cut out and others to be turned down, as desired.

Figure 3 shows a main single pole switch for cutting out all white lights on the stage and also a main turn down switch for toning all white lights feeding through these two switches, G G (Figure 2.) Current can thus be taken to the individual white border lights or to various border switches, as the case may be, thence for the border light switch to the lever of the three point switch W, and on to the lamps, whence the circuit continues to the main line and is completed. When a quick change is desired from white to red or blue, the switch lever is thrown from the point W to the point R or B, respectively, as required for use in tableaux or living pictures. Should the white and red lamps on the same border be wanted, then the lever on the three point switch will be set on the white point W, and the small angle switch on the same base will be closed on to the circuit R, when the main colored border switch may be turned on, or if the blue border is needed simultaneously with the white border, the other angle switch will be closed with the point B, and the main blue border switch turned on. Connected to each white border switch is a three point switch having two angle switches, R and B, all of which may be thrown on to the main colored switches, so giving control of each border individually or collectively, independent of the quick changing three point switch. The red border switch is not shown as it is, simply a duplicate of the blue one. The three arrows marked 2, 3, and 4, lead to respective three point switches and connect to the angle switch, as shown in B, Figure 3.

The installation described was designed by Mr. J. A. Lighthipe engineer of the Pacific Coast District of the General Electric Co., and installed under the direction of Mr. Frank T. Whorf. By its use it is possible to accomplish any combination or blending of lights that may be desired.

A LITERARY CURIOSITY.

Searchers for curious rendering of English and those who take as jokes books of the class of "English as she is wrote" would do well to look over our Berlin contemporary "Helios," where all articles are printed in German, French and English and are apparently written by the same German who speaks of a telephone station when he means a telephone instrument and a conduit when he means a wire besides in a thoroughly unique manner putting in his unintelligible "already" and stringing along his verbs at the end of the sentences until one reading the articles feels again like the school boy trying to get his Greek lesson with the aid of "crib."

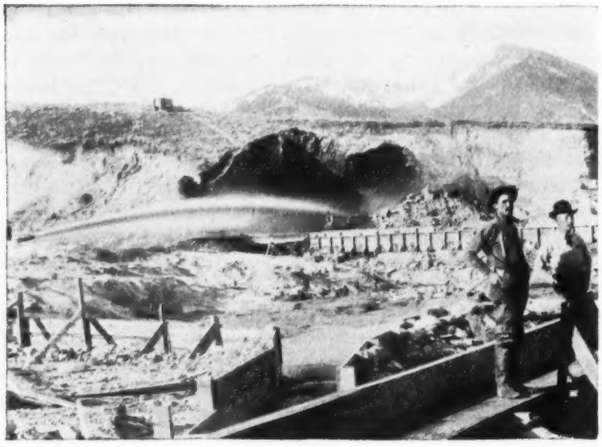
Mining

LIGHTING HYDRAULIC MINES.

By W. W. Briggs.

The difficulty in lighting large hydraulic mines heretofore has been in getting the light just where it was needed on the gravel bank in such a position that the man at the pipe could see the condition of the ground at all times. When we consider that the pipe washes on banks ranging from 50 to 150 feet in height, and that the method employed to get the gravel to the sluice is to undermine the bank, causing all the top dirt to come down with a rush resembling that of a land slide, also that the impact of a large body of water under high pressure against the bank throws a dense cloud of spray, the dissatisfaction attending the use of an ordinary form of arc lamp close enough to the work, becomes apparent.

In many portions throughout the West it is necessary to work the Placer mines night and day in order to fully utilize the water that is available only during certain portions of the year. Prior to the introduction of electric lighting, it was customary to build bonfires in huge pots, each of which would consume about 1½ cords of wood, costing $7.50, and requiring



Lighting Hydraulic Mines.

the services of one man costing $3.00, or a total cost of $11.50 per night per fire. Naturally therefore, the the item of illumination formed aserious one in the operation of a Placer mine, and the first steps taken to reduce this expense were made at the North Bloomfield mine in Nevada County, Cala., which installed a three lamp, 6.8 ampere Brush arc lighting dynamo in 1879. Open arcs were used and the plant is still in operation.

A recent installation at the mines of the Lemhi Placer Mining Co., in the Salmon River district, Idaho, has successfully overcome these difficulties and at the same time demonstrated that mines of this character can be better and more cheaply lit by electric light than by any other means.

A small ditch two miles in length was constructed which furnished water under 130 ft head for driving a 36 in., Pelton wheel for the dynamos, and also water for camp-buildings and fire purposes. The plant contains two dynamos; our ten lamp 2000 cp. Wood arc machine for the mine, and one 5 kilo-watt constant potential 110-volt machine for lighting the camp buildings.

The lamps which were generally placed behind the giants, were Thomson-Houston electric headlights mounted on stands to allow the raising and lowering of the front of the lamp by means of a hand scr··w so that the beam of light could be thrown on any portion of the mine. They were also fitted with turntables to permit the light to be thrown in any horizontal direction.

The lamps were never placed closer to the hydraulic giants than 300 feet and were arranged in two groups of three lamps each so as to break shadows, and the cost of lighting the mine in this manner is found to average $3.18 for a 12-hour shift.

The accompanying illustration of a Placer mine in the Salmon River district gives an idea of the difficulties encountered. The constant shifting of the scene of operations makes it imperative that the location of the light should be changed frequently. The electrical work is therefore largely of a temporary nature, and as a general thing the pole line is not a model of excellence, but while the character of the work is not such as will gladden the heart of the electrical engineer, he cannot but be lost in admiration of the beautiful effects produced in the illumination of these mighty streams of water. In some instances, notably in the Pioneer mine the writer has seen as many as seven rainbows in the spray.

DEEP MINING PUMPS—A SUGGESTION.

By A. L. Fish.

Having had a long experience in the utilization of machinery for mining purposes and being therefore quite familiar with the many difficulties attending the operation of pumps in deep mines, I have given some thought to methods by which these difficulties may to a certain extent be eliminated, or at least reduced by the greatest possible degree. It may be said in general that the placing of machinery in deep mines entails its operation under disadvantageous circumstances hence the conclusion follows that the greatest success will be attained by placing the pumping machinery on the surface. It is this idea that has prevailed in the erection of pumping plants under circumstances as would permit the operation of a direct plunger at the bottom of a mine having a perpendicular shaft, but this is a condition so seldom prevailing that it can receive no material consideration. The almost invariable practice has been to carry the pump and its motive power down into the mine and forcing the water up from it to the surface.

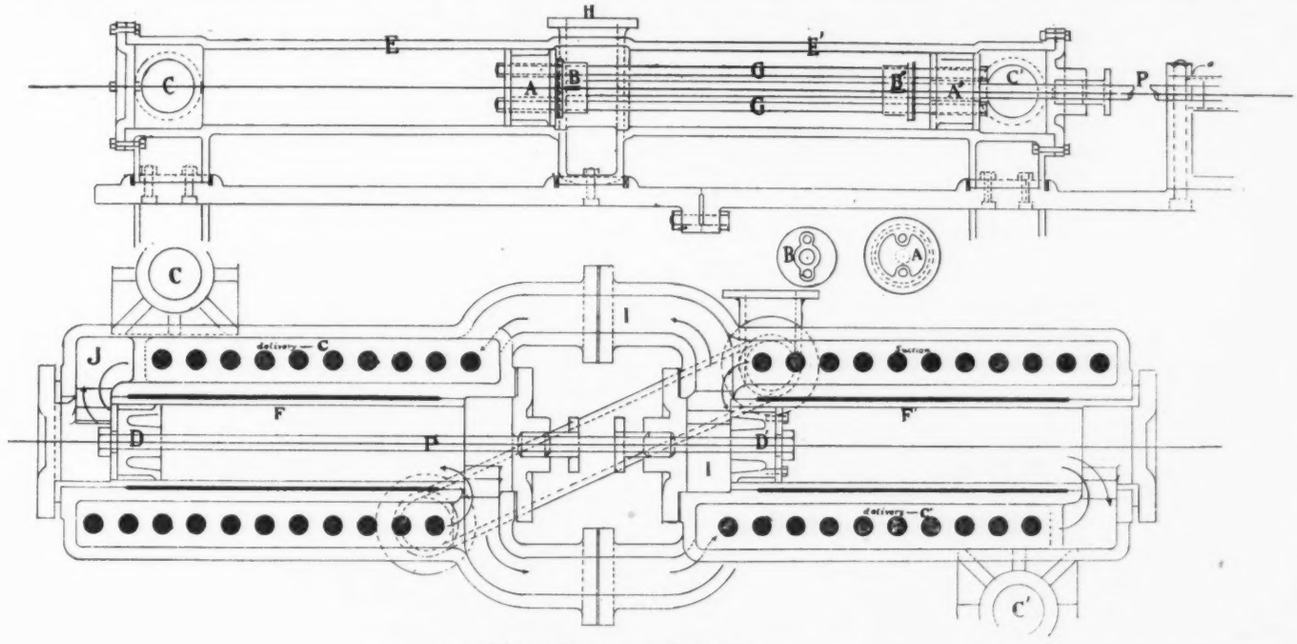
I have taken some pains to work out the details of a system which I think presents novel features and which I beleive to be the simplest device yet submitted. In brief, it consists of the utilization of a column of water placed in motion by suitable mechanism at the surface, and which delivers its energy to cylinders having pistons placed in the mine which when set in motion thereby overbalances the weight of a similar column of water, discharging an amount from it at the surface equal in volume to the capacity of the cylinder of the mine pump. The plan necessitates the use of two discharge pipes from the surface, which are used alternately for discharge and power purposes. The column of water merely constitutes therefore, a shaft or connecting rod forming an extension of the pump system. The power communicated through rod added to weight of one column of water forces mine waterwith receding clumn to surface.

Referring to the accompanying outline sketch, the two pipes referred to are designated as C and C. The mechanism contained in the cylinder E E is located

on the surface and really constitutes a force pump as its function is not to lift water but to force water down into the mine by means of power applied to the piston P by means of some suitable prime mover. The plan shows the arrangement of the parts of the apparatus just after having passed the extreme end of a stroke. The piston heads AA play in the cylinders E E respectively and are rigidly bolted together by means of the rods G G upon which slide the valve seats B B. These valve seats are rigidly keyed to the piston P, hence it is clear that the stroke of the piston is imparted to the piston heads through pressure of the valves B B on the hollow piston A A. It is clear that when the pump is making a stroke in one direction, in a left-handed direction, for instance, the valve A remains in open, affording a free way for the passage of water., from the pipe C into the cylinder E, thence out through the discharge pipe H.

In the mine the shaft pipes C C are coupled to the deliveries of the tandem cylinder pump C C as shown in the drawing, while the suction connections are shown with equal clearness. The pump piston P has rigidly connected to its extremities the piston heads or pump plungers D D, playing in the cylinders F F respectively. Both the suction and the delivery orifices, are fitted with suitable valves and the arrangement is that of a double acting pump with the exception that when the column of water in the pipe C is forced downward by the advance of the piston head A in valve saet B at the surface. The energy thus imparted to the water is carried through the chamber J, to the piston head D while advancing. The plungers D D throw the volume of water in the chambers F F into the shaft pipe C through the delivery valves C on the cylinder F. Obviously, then, as the volume of water forced down into the mine equals the capacity of the cylinder F (which is equal to that of the surface cylinder E or E'), this capacity is unity, and by the contrivances, the utilization of one unit of capacity of water has forced two units of water up through the pipe C, through the valve B, and the discharge exhausts H. In other words, the pumping down of one volume of water pumps up two volumes of water, and the difference is discharged. When the engine at the surface changes its stroke the valve B leaves the piston head A, the valve B closes with the piston head A, and water is forced down through the pipe C, striking the plunger D, which is at the right hand end of the cylinder, and the water in the cylinders F F is forced through the delivery valves and pipe C, to the surface as before. The suction chamber II is always filled with water taken from the mine, while the water discharged into the shaft pipe consists of equal parts of water taken from the suction and of water that has supplied the energy for the preceding stroke, as clearly outlined in the drawing.

The simplicity of the parts of the mechanism and the practically entire absence of the source of power from the mine likens the mechanism to that of a hydraulic ram, so far as the mine itself is concerned, to a remarkable degree. Neither depth of mine nor surrounding conditions as to dampness or other exposure will affect the operation of the system, and the advantages presented would seem to outweigh in many instances the additional expense that the construction of the two shaft pipes necessitates.



Deep Mining Pumps—A Suggestion.

PERSONAL.

Mr. H. Fisher Eldridge, of the Portsmouth Electric Company, of Portsmouth, N. H., is visiting San Francisco.

Mr. John Maguire, president of the Maguire Manufacturing Company of Chicago, builders of the well-known Maguire railway truck, is wintering at San Rafael, Cal.

"The Journal of Electricity" is an admirable publication in every way, and deserves the support of everyone interested in electrical matters.—L. B. Pemberton, Los Angeles, Cal.

The specimen copies of the "Journal of Electricity," which you kindly sent induced be to become a subscriber. Herewith I enclose a cheque for $2.00 for one year's subscription.—I. Fujioka, Lecturer in the Engineering College of the Imperial University, Chief Engineer of the Tokyo Electric Light Company and of the Miyoshi Electric Manufacturing Company, Tokio, Japan.

A NOVELTY IN STEAM YACHTS.

Many of the yachtsmen who frequent the Marin County shores of the Bay of San Francisco have experienced considerable chagrin during the past summer by having their steam or gasoline launches distanced by a curious little whale boat that darted in and out of Tiburon courting "brushes" with the crack launches of the yacht clubs. This peculiar little craft did long service in the Artic region as a whale boat until with the waning of the whaling industry it was secured by Mr. John Bonner, now Master Mechanic of the San Francisco and North PacificRailroad Co. who equipped the boat with interesting machinery of his own designing and which has been described briefly in a recent issue of "Power", without reference however, to the specific use to which the machinery has been placed.

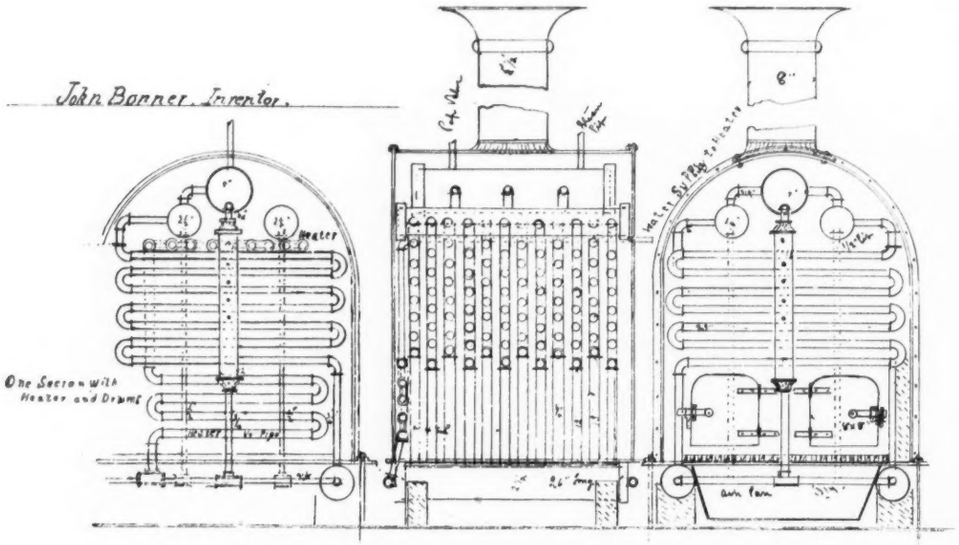


FIGURE 3—*A Novelty in Steam Yachts.*

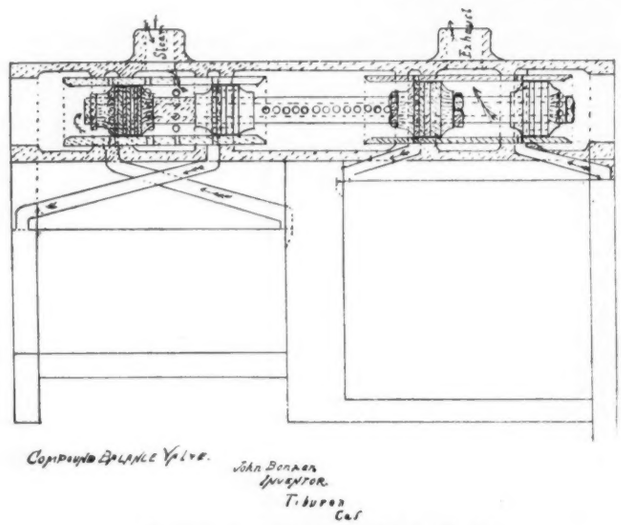


FIGURE 2—*A Novelty in Steam Yachts*

The hull of the boat measures 30 feet in length and is of 6 foot beam, having an estimated capacity of three tons burden and it easily attains a speed of thirteen miles per hour over a measured slack water course. The steam equipment is clearly shown in Figure 1, and consists, of a water tube boiler of a novel construction, that is licensed to carry steam at a pressure of 250 lbs., per square inch, and a com pound steeple engine, the particular novelty of which is the balanced reciprocating valve motion. The boiler shown in outline sketches in Figure 3, constitutes a very cheap, simple and compact appliance, in which a thorough circulation is maintained, in which a great amount of heating surface and a large grate area are afforded, and in which the steam is thoroughly separated from the water. The construction gives ready access to all of the parts, and as no special styles of fitting are required in its building, the boiler may be readily set up by a skilled gas or steam fitter from standard pipes. The boiler, including its casing, weighs 350 pounds, and its dimensions are 20 x 24 x 34, and it is ordinarily run at 180 pounds gauge pressure. The boiler is made throughout of 1-inch pipe, with standard fittings, and, as shown in the cut, contains two mud drums, two separators and one superheater.

The dimensions of the engine are, $2\frac{3}{8}$ x $4\frac{1}{4}$ diameter, by $4\frac{1}{4}$ stroke. Its weight complete is 90 pounds, and it drives direct a 3-blade, $22\frac{1}{2}$-in. phosphor-bronze propeller. As stated, the peculiarity of the engine rests in the valve motion, which is fully shown in Figure 2. Among the advantages of Bonner's reciprocating valve is the fact that its construction does away with the use of a receiver, the steam chest and all pipe connections, together with the use of one set of links and eccentrics. The valve is a solid tube, and is all lathe work.

The engine as here erected will deliver $7\frac{1}{2}$ nominal horse-power continuously at 400 revolutions per minute, and the mechanical features of the reciprocating valve are such that if desired, the engine may be run at the speed of 1,000 revolutions per minute, or even greater.

EXTRAORDINARY ABUSE OF BOILERS.

The important decision in the contest between the Philadelphia Edison Electric Light Company and the Abendroth and Root Manufacturing Company has been extensively noted in all the electrical papers. The accidents occuring to the Root boilers in the Philadelphia station have been much discussed and widely exploited by competitors of this water tube boiler. It is therefore gratifying to learn that the boiler manufacturers have been completely exonerated in the courts and the blame for the accidents laid upon the Philadelphia Edison Company. One of the most remarkable facts brought out in the case was that in reference to the manner in which the boilers had been handled. How far such work is practiced in electrical supply stations will perhaps never be known though it is interesting to note the methods used in this case. The instructions to firemen given by the Edison Company were that full steam pressure should be maintained at all times whatever the hazard, with the result that the boilers were often called upon to steam at more than twice their rated capacity, so rapidly that at times the tubes of the boilers could not deliver the steam as fast as it was made and actual superheating took place in the water tubes, with the result of many burnt out tubes and of boilers broken under the influence of water hammering within the boiler itself.

When the wind blows all straws point one way and this with many others at the present time point to the necessity of cheap and efficient storage in order to relieve all parts of the machinery in the station from excessive strains and uneconomical systems of working.

SPLITTING SCIENTIFIC HAIRS.

A curious computation has been made by Mr. Alexander Hogg of Fort Worth, Texas, on the influence of the revolution of the earth on the speed of the trains. His object in making the calculations was to show that when the New York Central road made its record run on September 11th of 436.5 miles in 407 2-3 minutes, or at an average speed of 64.26 miles an hour, it retarded the speed unnecessarily by running from New York to Buffalo, instead of in the opposite direction. His figures indicated that the difference of weight in the New York Central train when running east and when running west with a speed of sixty miles an hour is, on account of the revolution of the earth, about 1-830 of the total weight when at rest. As the train weighed 565,000 pounds, this computation indicates that if the run had been toward New York the engine would have had to haul about 309 pounds less. These figures have been analyzed by another engineer, who finds some slight errors in the mathematical part of the theory. He says that the increased weight going west is about 154 pounds, and the decreased weight going east about 183 pounds, making the saving by going east about 337 pounds. He also suggests in a sarcastic manner that as the moon draws movable bodies away from the earth when it is above us, it might be well to suggest to the New York Central officials that, as the tides travel from east to west, they may perhaps offset the disadvantages shown by Mr. Hogg by starting when the moon is propicious, and, as they would "keep in the tide" while going west, they may still be able to make fast time in that direction, even if the engineers learn of the disadvantages of centrifugal force when they are trying to make Buffalo.

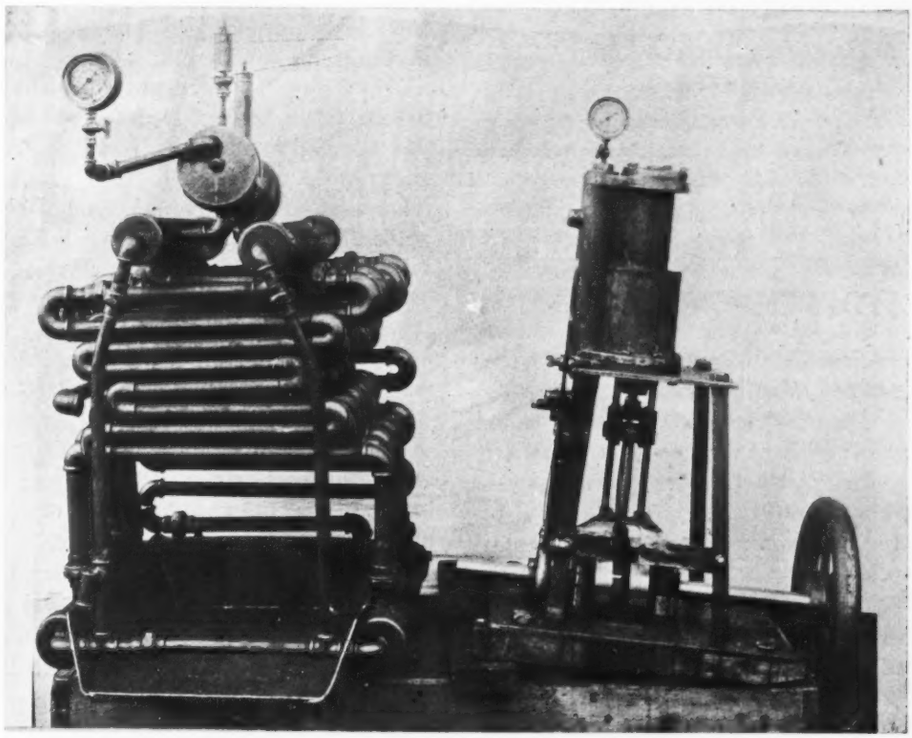


FIGURE 1—*A Novelty in Steam Yachts.*—(*See Page 8.*)

The Journal of Electricity.

An Illustrated Review of the Industrial Applications of Electricity, Gas and Power.

EDITED BY

F. A. C. PERRINE, D. Sc., and GEO. P. LOW.

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EDITORIAL.

CONCERNING MUNICIPAL OWNERSHIP

The discussions of the municipal ownership of quasi-public works such as the telephone, street railroad, the electric lighting plant or the gas plant have been so distinctly colored by wishes of the authors in the discussions that one is often at a loss to determine what is the true basis of comparison. In one plant where the operating cost is low the advocates of private lighting will attempt to show that important items are omitted from the calculations; in another, they will preach upon the injurious effects due to the increased number of office holders entailed by such a plant. The advocates of municipal ownership argue now upon the low rates to consumers and again upon the freedom from franchise difficulties enjoyed by those cities having their own supply plants. No common ground seems to have been reached in the discussions and no satisfactory means of comparison of the various plants attempted have been suggested. The extreme advocates of municipal ownership will occasionally admit that they regard nothing beside the cost of supply to the consumers, arguing that it matters little to them whether the muncipal plant is operated in a manner economical or uneconomical provided that they are supplied with lights at a low rate. Such a ground seems to be entirely untenable to a student of sound economics and if we take either extreme it might rather be said that we care nothing for the rate of supply but only for the cost of production since an excessive rate is a matter which cures itself by inducing competition.

It is every man's individual business to see that the rates he is paying for his supplies are not beyond the limits of a reasonable profit, but a wasteful production is an eternal waste of the world's store of labor and energy and it is no more good economics to pay many men small sums for work they are doing badly or not at all than it is to pay a few excessive profits upon their business ventures. The question therefore is not one of rates entirely, but is primarily one of engineering; that system must be judged to be the best which will bring out the best engineering and furnish the supply at the lowest rate of production whatever may be the charge for distribution. It is unfair to charge interest rates upon such a municipal plant as that in Detroit, where maintenance charges are included in running expenses, when under similar conditions interest charges would not be made in a private manufacturing concern; on the other hand there are but few of the municipal plants installed upon the best of engineering lines and manipulated economically and it seems that such a condition must necessarily hold until the time comes when the great bribes now offered for successful political jugglery may be removed from the field of politics. If there were no tariffs to vote which could enrich the friends of congressmen, no harbor bills to advance the price of their real estate, no rise or fall of stocks that might be influenced by their votes, it would then be possible for men to be elected to government offices who would administer manufacturing establishments economically but until that time comes, the politician will be the man capable of taking financial advantage of his public vote and it is hardly within human probaility that men of this class will ever lose their hold upon the smaller concerns of everyday life or administer public works economically or to the best financial advantage of the people at large.

HIGH POTENTIAL SYSTEMS

We noted in last month's issue the installation of a plant on the Pacific Coast equipped with 220-volt incandescent lamps. It is interesting to find that these high voltage incandescent lamps can be manufactured in such a practical manner that they may be used in a business installation but we must remember that there is more in this departure than the comparatively simple problem of lamp manfacture. The use of a 220-volt lamp in a simple multiple arc distribution effects a greater saving than can be accomplished with the ordinary 110-volt lamp on a three-wire circuit, but as a three-wire distribution has not been found capable of completely solving the problem of a wide lighting district we may expect that the introduction of this high voltage lamp will be immediately followed by its use in the multiple wire system, which may mean the eventual introduction of a potential at least as high as 440 volts between the outside mains of the three-wire distributing system. Already we know that Edison Companies have encountered much difficulty in installing its low voltage three-wire system without the presence of excessive leaks especially where the wires have been laid under ground. With the doubling of the voltage we must therefore expect to see the abandonment of their low insulation methods and the question at once arises whether satisfactory cables and junction boxes can be obtained for a house to house distribution using this high e. m. f. and if they can be obtained whether it will

be possible for them to be economically installed. English engineers have been much concerned about the insulating powers of fittings and it is said by their journals that a complete reorganization of the requirements for fittings must take place before high voltage lamps may be considered as safe. In this country we have for some time past used in the best installations only a thoroughly vitrified porcelain as a support for the contact points in either switches, fuse blocks, sockets or lamp bases, and, provided the clearance spaces are great enough, it is hard to see how there should be any necessity for a better system of insulation than we are now using. All of our switches and most of our sockets are designed of ample proportions to withstand an e. m. f. as high as 220 volts and this has been proved throughout the country by the extensive use of standard fittings across the outside mains of the three-wire systems where motors are installed. The safety fuse system will require a complete reorganization where these high voltages are employed but, as such reorganization is already in progress for application to our present system, the changes necessary will be easily made since we are daily learning the requirements for the safety fuse upon any circuit. These things being so, it may be considered that the problem of the installation of high voltage incandescent lamps upon either two or three wire circuits in this country involves mainly the question of the quality of the incandescent lamp itself. Our manufacturers have looked with suspicion upon any lamp of higher voltage than 110 volts, but we find that in Berlin 150-volt lamps have for the past five years been successfully used with candle powers as low as five and eight, which is certainly a matter of greater difficulty than the manufacture of a 220-volt 16 c. p. lamp. Two and a half and three-watt lamps have been successfully produced on this side of the water and in the light of these facts there seems to be no reason why American manufacturers should not turn out a 220-volt 3½-watt lamp with a 600-hour life which would be fully satisfactory to central station men and purchasers of current. There seems, therefore, to be no reason for apprehension in the installation of this system either on the score of danger to life or from fires; though this increase in voltage will make more than ever necessary the rigorous inspection of every electrical installation and require throughout the system a more perfect class of workmanship.

CROAKS AGAINST EDUCATION

One of the most important problems at present faced by electricians is found in the electrical engineering profession. We may properly question whether there is a present need for the great number of electrical engineers annually graduated from our various technical schools, whether the education offered by these institutions is calculated to fit their graduates for the duties of life or whether the opportunities offered to the graduates sufficiently warrant their becoming electrical engineers. This extensive system of electrical engineering education has been called by some an electro-mania and condemned consequently in a wholesale manner, the statement being made that the young students are deluded by the remarkable opportunities offered in times past to those who were familiar with the electrical science. This seems to be a part of the general outcry that complete education will unfit men for the common everyday duties of life and render them less rather than more capable of earning their living in business fields. Possibly there is a foundation for this wailing over an electro-mania should the graduate of a technical college look for employment solely as a well-paid engineer within the restricted lines of the profession called electrical engineering, but we believe that a broader view of technical education and especially of electro-technical education will alter the conclusion very considerably. Should the graduates only be fitted for designing electrical apparatus or the management of large central station plants it would undoubtedly be true that more men are being yearly educated than can possibly find employment, but with the advance in the application of electro-technics to the business of the world we find that not solely in the manufacturing, designing and superintending branches of the business are men required with extensive electrical knowledge, but that within the lines of many other businesses and professions electrical knowledge forms a strong basis for usefulness. A few companies throughout the country may be monopolizing the installation of electrical machinery but at the same time the general introduction of electrical operation is hindered by a lack of knowledge on the part of possible users of electrical apparatus. The mining superintendent who lacks sufficient knowledge of electrical processes to manage such machinery will hesitate before making use of it though its economy may have been definitely proven to him where it has been installed under favorable conditions. The transmission of electricity and its extensive application from natural sources of power is greatly limited by the lack of knowledge on the part of superintendents of manufacturing concerns and of business men whose capital is involved in them. Indeed so many elements of detail must be considered before the steam engine plant may be economically removed in favor of the electrical transmission plant that it can only be contemplated by one capable of judging the comparative efficiency of the two plants under the particular circumstances, and without electrical knowledge this judgment may not be satisfactorily arrived at. Many of the older mechanical engineers realizing this have made themselves familiar with electrical processes so thoroughly that they are amongst our best electrical engineers and this should be the goal held before the young electrical engineer that his knowledge does not limit his usefulness to a single specialty, but that by it he has become familiar with a new source of energy and that he has at his command the method for the transformation of power which is not available to those unfamiliar with his science. The acquirement of an electrical engineering education is not therefore to be con-

sidered as limiting a man's power but rather as a means of making him better adapted to entering complex fields of business, of manufacturing or of the transformation of power with a mind not limited to one source of energy transformation, but equipped with a knowledge of the usefulness of many. It is his duty to guard against the unreasoning application of electricity as well as to boldly appreciate its availability when it may introduce any economy. So long as the world stands we will hear this croak against education as we do that against the introduction of machinery; and it is a source of congratulation rather than of fear when we realise that the mass of men appreciate the value of advancing knowledge in spite of the reprogressive spirit manifested by a few individuals.

FOR PEACE OR FOR WAR

Listening to the rumors of possible war between the most highly civilized countries of the world we are every day struck with the fact that our boasted civilization has not eliminated from men altogether their pugnacious character; nor, so long as development consists in a combat with environments, should we expect that pugnacity should be eliminated from humanity. Whether we have war or not is determined therefore by our circumstances and whether a nation has more to gain or lose from combat with some other people. Every advance that we have made in the arts and sciences is involved in this question and we naturally ponder over the possible effect for peace or for war of our latest engineering development. Much of this development has been concerned with the introduction of electrical engineering; does the science of electricity therefore make for peace or for war? Every warship, every battery, every command of men is equipped with electrical appliances of one sort or another, making the engines of destruction more certain and more terrible in their action, making war more deadly and more to be feared; but fear does not always deter men from combat, though it may compel them to require a grevious cause for fighting. Looking at it in this way the introduction of electricity, as the introduction of the Maxim gun, may be said to make for peace. This, however, is not the true peace nor a strong bond between communities. What we have done in uniting the business relations between people and what we have done toward making the mutual understanding of one universal thought more easy is the true possible advance. The telegraph has created a financial solidarity amongst business men which involves all nations in the loss of any one. Disasters in the Argentine were quickly felt in London and spread to the entire world, the news and the effect flying over wires across mountains and beneath seas. Every man throughout this broad land makes daily use of the manufactures of the world and no great manufacturing company, wherever it may be located, can be considered as localized in its influence, foreign capitalists have invested in its shares and foreign purchasers use its products. Diplomatists feel that a slight conflict between any two civilized nations will involve the whole civilized world and this because the telegraph and the telephone have enabled all peoples to be involved in another's prosperity. This makes for peace more strongly than any show of armed force or any development of destroying machinery and is more the safeguard of harmony between nations than are the fleets and the armies of many powers.

THE VAN DEPOELE DECISION

It is difficult so soon after the recent decision sustaining the Van Depoele underrunning trolley wheel patent to estimate its complete significance and until the final decision before the Supreme Court it may be too early to believe that any importance whatever is to be attached to it; but at the same time the patent seems to be one of unusual clearness and the decision is unusually emphatic therefore we must consider that the situation must be faced, even should the rumored consolidation between the Westinghouse and General Electric Companies be effected. This decision, if affirmed, would place in the hands of the General Electric Company the entire present system of trolley railroads and where motors other than their own are used upon any roads either some new system of trolley contact must be adopted or a royality paid to the owners of the patents. The policy of exclusion of all other motors from the field can hardly be contemplated by the General Electric Company unless it is willing to face combined opposition from all the electric railroad managers since it is not conceivable that they will submit calmly to any system which will shut out competition between motor manufacturers and which will compel them to use but one class of apparatus. Underground conduit roads cannot be considered as a complete solution of the problem since the conduit has not yet been developed into a financial sucess, however completely the engineering difficulties have been overcome. Sliding shoe contacts have been used to a considerable extent and the Siemens-Halske people have employed a single stretched wire, though until these methods can be installed noiselessly they would hardly be tolerated in addition to the present objections to trolley construction.

Electrical patents sustained only after many years of use involve so many interests and raise so much opposition that their complete exploitation in the hands of any one company involves so great an amount of diplomacy that up to the present time not one has proven itself to be greatly to the financial advantage of its owners and there is no doubt but that this history will be repeated in the present case though it behooves the users of the underrunning trolley wheel to prepare for a fight upon patent rights in which their own position may be made strong only by a firm co-operation amongst themselves.

Passing Comment.

AN EDITORIAL REVIEW OF CURRENT EVENTS AND PUBLICATIONS OF OUR CONTEMPORARIES.

ELECTRICITY FROM GARBAGE CREMATION.

In the "Electrical Engineer" of December 11th Maurice Barnett calls attention to the fact that American engineers have taken but slight advantage of garbage crematories for the economical distribution of light and power. The subject explained by Mr. Barnett is not as simple as might be considered by the casual observer. It is not possible to drive the furnace of a garbage crematory at a varying rate, as the fuel to be consumed contains a vast amount of water and ash so that it is only with difficulty that it may be made to burn at all. In many cases the heat obtained by the consumption of the dried product is only just sufficient for drying the green refuse and where there is a surplus of heat the amount is so small that it can only be made available where the production of power proceeds at a steady rate. The problem, therefore, is one of the storage of energy. In Germany, where storage batteries are cheap, the energy has been stored electrically from garbage crematories and even in small cities a considerable expenditure for machinery and storage batteries has been found to be economical. One plant in England uses thermal storage upon the Halpin system which has been advocated in this country by Nelson W. Perry. This of course requires a greater amount of storage capacity than is necessary where electrical storage is made use of since the energy consumed in engines and dynamos must be retained as well as the energy used for lighting which determines that thermal storage is only justified by the excessive cost of electrical storage. With the decrease in the cost of storage batteries that seems now inevitable, and with a growth of confidence in their reliability we may hope in the future to see the energy contained in the offensive garbage piles of many of our smaller cities made use of for their illumination.

HOUSES FOR TROLLEY SUPPORTS.

We are so accustomed in this country to find the householders in narrow streets antagonizing by every means in their power any electric railroad passing in front of their doors that it does not occur to us to think that the blame must lie somewhat upon the management of the electric railroads. Surely this must be to an extent true, for we find that in Germany, where we commonly understand the burghers to be less progressive than those of our own cities, co-operation between householders and the trolley roads extends to the permission for the attachment of trolley supports to the houses along the line, these trolley supports being carefully designed by architects to conform with the general design of the houses themselves. One of these supports, illustrated in the "Electrical Engineer" of December 18th, shows how carefully the work is carried out and may be a lesson to our trolley road managers that steps towards the conciliation of their neighbors will not be to their loss, but rather to their own financial advantage.

THE BURTON ELECTRO-SMELTING PROCESS.

We noted a couple of months ago some of the absurd claims made by George D. Burton for his method of electro-smelting where, assuming that his process was perfectly efficient, almost three times the amount of heat was required for the work which he claimed to do than was delivered to the apparatus. We note in the "Electrical World" of December 7th an article by Paul Hoho on Hydro-electro-thermal heating, where some experiments have been performed with the "Water Pail" process used by Burton with the result that in place of an efficiency of 100 per cent only about 37 per cent of the energy was made available. While this low efficiency is all that has so far been established for this process the method seems to offer many possibilities in practical work where great efficiency may be neglected.

The method consists in connecting the object to be heated to the negative electrode of a dynamo capable of delivering upwards of 150 volts and plunging the object into a salt water bath contained in a vessel connected to the positive pole. A layer of hydrogen is immediately formed around the negative electrode and as an arc is established across the hydrogen envelope the object is heated with only a slight elevation of temperature of the enclosing bath. This does away with the expensive transformer of the Thomson system and as the heated object is enclosed in a hydrogen envelope the injurious effects of an arc in the open air is avoided. The process seems to be one well adapated to such work as the local annealing of armor plates which has recently been described and to many forging processes applied to small objects in which the Thomson system cannot be made applicable. It is seen therefore that the method has its legitimate place aside from the absurd claims that have been made of its efficiency.

CLAIMANTS FOR TELEGRAPHIC HONORS.

The publication of the letters from descendants of Alfred Vail and Joseph Henry as claimants for the honor of having invented the electro-magnetic telegraph have led many to suppose that the "Electrical World" was taking up in a partisan manner the claims of these workers to the belittling of the name of Morse, but those who have perused and criticised these articles should not judge our contemporary before reading the able editorial contained in the number of December 28th, where we see that their aim in allowing these publications was rather designed to set forth the part that each discoverer and inventor has played which truly belongs to him than to raise one at the expense of the other. The history of the electro-magnetic telegraph in this country is indissolubly connected with the three names of Henry, Morse and Vail. Henry discovered the proper connection of the magnet and battery necessary to make the sounder act; Vail undoubtedly developed much of the mechanical contrivances while to Morse belongs the great honor of devising a practical alphabet and using an indomitable energy in carrying out the completed system. Morse's work would perhaps have been beyond his powers without

the assistance of the other two, but to neither of the others belongs the honor of the introduction of the telegraph and its practical application as it does to Professor Morse. The history of this great invention is as the history of all other applications of important discoveries, to no one man belongs the whole thanks of the world for his invention; without the work of those before him and the aid of his contemporaries he cannot carry to complete success any great system, while at the same time the honor of completing the system and making it available for man's use is sufficiently great to make his laurels everlasting.

TRANSFORMER LEAKAGE.

In the "Electrical Engineer" of December 25th we notice an article on the loss of revenue due to transformer leakage current by S. S. Armstrong which calls to the attention of every engineer the necessity for a thorough understanding of accurate methods of measurements before too much reliance can be attached to his results. This article points to the advantage in the use of large transformers on account of the reduction of leakage losses and while we do not wish to quarrel with his conclusions but rather to commend to the attention of all managers of alternating stations the results in this paper, a word of caution is necessary concerning the measurements which he advises engineers to make on their transformers. Apparently one might follow Mr. Armstrong's instructions for obtaining a measurement of the electrical energy in an alternating circuit without taking into account the angle of lag between the electro-motive force and current, and should the central station manager neglect this factor the results obtained by him would be largely inaccurate.

REMOVING CARS IN CASE OF FIRE.

The need of some method of quickly running the cars stored in a car-house from the house in case of fire is important, and has led to the adoption of various expedients, of which perhaps the best known is that of having the tracks pitched at a slight grade, so that the cars in case of need can be quickly run out. This involves keeping the brakes continually set, and in certain respects is somewhat inconvenient to construct and use. A new method has recently been patented by one of the employes of the Detroit Railway, of Detroit, Michigan, and is certainly ingenious in conception, says the "Street Railway Journal." The tracks are level, but the trolley wire running over each track is furnished with a cut-out switch located near the exterior of the building. When the cars are left for the night this switch is opened, leaving the trolley line dead, and each controller is put on the first point. In case of fire an employe has simply to turn the switch operating the trolley line over the track, and the cars immediately file out at a slow rate of speed. In case the motors on one car are disabled it is pushed by the one immediately in the rear. When these cars are safely out the switch controlling the trolley line over another track is thrown in, and the cars on that track are safely removed from danger.

Literature.

ELEMENTS OF THE MATHEMATICAL THEORY OF ELECTRICITY AND MAGNETISM BY J. J. THOMPSON, M. A., F. R. S., NEW YORK: MACMILLAN & CO.; PP. 510. PRICE, $2.60.

The publication from the able pen of J. J. Thomson of a systematic mathematical treatment of the subject "Electricity and Magnetism," including not only the simpler division of static electricity and constant current actions but also the subject of electro-magnetic induction will be welcomed by all teachers who have felt the need of a complete and accurate work bridging the space between the simple study of phenomena and the more advanced applications to electro-magnetic machinery. Up to the present time this field, which may properly be called the mechanics of electrical action, has been covered in a thorough manner only by the difficult treatises of Maxwell and Gray, both of which are beyond the comprehension of the ordinary student and make use of systems of mathematics in their treatment which can hardly be included in the necessary equipment of an engineer; while on the other hand, the work of Mascart and Joubert does not examine with sufficient completeness the subject of electro magnetic induction and when used as the basis for further study presumes too much upon the independent mathematical ability of the student.

With the exception of these three treatises we have mentioned other authors have gone so far in their attempted simplification of the subject as to avoid the use of the Calculus and in consequence have presented the subject in a manner not only inexact, but confusing to the student who wishes to read some more advanced treatment of alternating current phenomena and allied subjects.

It is not often that we read in an author's preface the statement that no mathematics more advanced than the calculus will be employed in the treatment and yet this statement which is made by Professor Thomson rationally conforms to the present state of development in the study of electricity and magnetism. The student who is expecting to obtain a complete knowledge of the development of electro-magnetic machinery must at the outset face the need for the continued use of calculus treatments as such treatments are to be found in all books which give the systematic theory of the dynamo, the transformer and the alternating line, treatments which will be unintelligible to the student who has not laid a firm foundation in the mathematical treatment of this part of the subject we have called the mechanics of electricity and magnetism. To those equipped with an understanding of quarternions and the system of vectorial analysis there is no doubt but that the treatment of many electro-magnetic problems may be simplified by their use but up to the present time such methods are not available to any except the most advanced investigators; while the system of the calculus is at the present time within the grasp of all educated engineers.

Being a strictly mathematical treatise, Professor Thomson develops electric, magnetic and electro-magnetic actions from the laws of Gauss, Ampere and Lentz; deriving electro-magnetic induction from the equations of energy as should properly be done rather than in the ordinary roundabout manner from experimental knowledge and advanced mathematical deductions. In treating the magnetic field of force about the magnet and a current Professor Thomson does not hesitate to proceed by the exact method which necessitates three-dimensional equations and here will be found a difficulty in the path of students whose mechanics have been confined to the plane. This action calls for an advance in the treatment of such subjects beyond that given in most of our engineering schools and colleges. Electrical engineers feel this need more distinctly than any others while the exactness and elegance of three-dimensional treatment will be found to compensate for the slight increase in the difficulty of the treatment.

Without particularizing at all we believe that we have pointed out a distinct advance Professor Thomson has made in this elementary mathematical treatise and we wish to emphasize that the study of the book will equip students for a more ready handling of energy equations and for following the advances in either electro-magnetic research or its application to modern electro-magnetic machinery.

ELECTRICAL EXPERIMENTS, by G. E. BONNEY. New York: Macmillan & Co.; 250 pp. Price, 75 cents.

In the preface of this "Manual of Instructive Amusement" the author has thrown out a suggestion worthy of considerable enlargement and in light of which his work may be criticised though with the understanding that the plane of criticism is far higher than any intent of the author when undertaking his book originally. In the preface, while enumerating a considerable list of books needful for the complete study of the subjects he is taking up in this manual, the author says: "When the cost of books and instruments is likely to exceed the means of any one experimenter it will be advisable for several persons to form a club or class for amusement and purchase the books and material from the common fund to which all subscribe; clergymen, schoolmasters the youth in our country districts could do service by organizing such clubs." When we read this advice for the proper carrying out of his experiments for amusement it immediately occurs to our mind that throughout the land not only in the country districts but also in the cities are already many clubs formed for the instructive amusement of poor boys and from what we know of the operation of such clubs it would seem that the suggestions of Mr. Bonney might come as a great relief to their managers who are often racking their brains for entertainment that will sufficiently amuse and keep the attention of their charges. Nothing has ever proved to be more wonderful to the boy whether young or old than the mysterious attraction of a magnet for pieces of iron or the curious alternative attraction and repulsion of fine particles to an electrified rod. Founding a course of amusement upon these simple phenomena it is generally easy enough to excite enough interest for the investigation of the phenomena to be undertaken by the student and even to make one who approaches these experiments from the side of amusement merely to become quickly imbued with a desire for becoming a student where a studious disposition in all other lines is entirely lacking. Much good has been done in such clubs for many years past by the various Agassiz associations fostering an interest in studies in natural history, but unfortunately such studies do not appeal to all nor can they be readily carried on during the long winter evenings and away from fields and flowers until considerable advance in the studies themselves have been made, disadvantages which are not attached to the studies of physical effects and especially those belonging to the elements of electricity and magnetism. Without preliminary instruction in such amusements it is generally found that the leader himself is soon at a loss for further lines of instruction and amusement and in such a contingency this book of Mr. Bonney's is eminently adapted to supply directing hints.

A criticism of the book itself as a means of instruction rather than amusement would point to some very serious defects in the treatment especially where he undertakes to carry an understanding of the subject far beyond the effects pointed out by his experiments, as for instance, where he attempts to explain the relation between electricity and magnetism by reference to Sprague's curious analogy of light polarization. In a few cases his statements are absolutely at variance with the results which might be observed, referring as he does to magnetizing one-half of a steel bar at a time by a single touch as though one end of the bar could be magnetized without affecting the other. When he attempts to explain magnetic saturation there is a hopeless confusion between amperes and ampere turns, but as we have said in the beginning a criticism of this book as a manual for exact instruction places it on a higher plane than ever intended by the author. The experiments described when considered as a means for amusement from which instruction may not be eliminated are in the main simple and of such a character that they may be carried out by any one having a common school knowledge of physical phenomena, though in some cases he attempts to make even this branch too complete for the ordinary experimentor since the magnets necessary for the demonstration of dia-magnetic polarity can rarely be found even within the means of a club unless they are willing to expend a very considerable amount of money. Some would perhaps be daunted by the prices he places upon the apparatus necessary for his experiments and it would have much advanced the applicability of the book had he given rough sketches of the appartus that might be home made, though from the pictures one with a little skill in mechincs could easily supply these deficiencies. On the whole, the course of amusement if faithfully carried out will undoubtedly advance the knowledge as

well as the interest in such matters of any club which would be wise enough to undertake to follow this book and we hope that the suggestion thrown out may be taken advantage of by the managers of boys' clubs throughout the country.

CATALOGUE OF THE HOPKINS RAILWAY LIBRARY, by FREDERICK J. TEGGART, B. A. Published by the library of the Leland Stanford Junior University; pp. 225.

We have before us a remarkable catalogue which forms in itself almost a monograph upon railroad literature describing as it does one of the best collections of railroad literature that has been made up to the present time. The library is one that was commenced by Mr. Timothy Hopkins in San Francisco while treasurer of the Southern Pacific Company and presented by him to the Stanford University in 1892, at which time the collection numbered about 2000 volumes and pamphlets. Fortunately Mr. Hopkins also amply provided for the maintenance and increase of this library with the result that it has been possible to edit so very extensive a catalogue indicating the present condition of this valuable collection.

The classification adopted is one which aims to diminish as far as possile the necessity for cross references and it is found that a system has been adopted which renders the works enumerated surprisingly accessable without the extra labor demanded by an extensive system of cross references, a method more likely to confuse the investigator than to aid him on account of the fact that a cross reference catalogue depends for its value upon the completeness of its subdivision—a quantity variable with every investigator. The system here adopted confines each book or report so far as is possible to the individual railroad upon which it has been used and admits of departments such as economics, law, construction, equipment and operation only in those treatises directed especially towards those subjects. In the main the collection has been gathered with reference to standard steam railroads and in this field it is remarkably complete, though it cannot be claimed to be nearly final except in the railroads of the United States and particularly those of the Pacific Slope to which more than thirteen pages are devoted. The primary attention to standard steam roads is especially apparent when we notice that amongst the periodicals and transactions some of the more important street railroad publications are altogether omitted. For instance, no mention is made of the "Street Railroad Gazette" or the "Street Railroad Journal' or of the important street railroad papers presented to the American Institute of Electrical Engineers. In the section especially devoted to electric railroads, Reckenzaun's book on "Electric Traction;" Herring's "Electric Railways" and Martin & Wetzler's "Electric Motors and Their Applications" are not to be found. In some of the subjects treated the absence of papers upon important subjects indicates that insufficient treatment of these subjects have heretofore been undertaken, probably because these subjects were still in their growing state; particularly we notice in this connection a comparative absence of works on signals, on telegraph, and other electric applications. Cableways and cable railroads are mainly represented by trade publications or by historical matter contributed by the early engineers of such means of transportation located on the Pacific Coast from which they had their origin in this country at least.

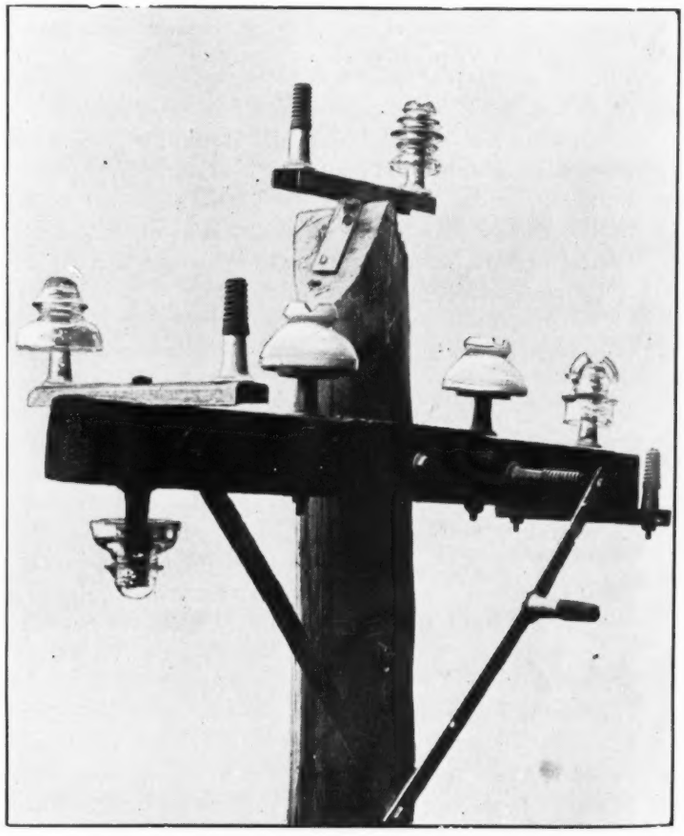
In reviewing this book we are struck in the main with its completeness and with the wide range of subjects treated from which we should judge that the collection is rapidly growing to be most important for the student of any class of railroad problems, whether he is concerned with standard roads in their construction, operation or economical circumstances or whether he is considering the minor fields of tram roads or subsidiary haulages.

The Trade.

In Responding to advertisements in this publication, please mention "The Journal of Electricity."

HIGH GRADE PORCELAIN EQUIPMENTS.

In no department of engineering has it been so fully or so frequently demonstrated that good work and good materials pay, as in the field of electrical transmission



Some of Fred M. Locke's Line Specialties.

and application of power. Cheap devices, like cheap labor, particularly in the field of electrical transmission, not only means a constantly increasing repair account,

but create the probability of failure until such time as the cheaper materials have been replaced by those of the highest quality. An increasing repair account almost invariably forms an unnecessarily large item of expense that makes serious inroads into the dividends of the operating company.

A full appreciation of the fact that the transmission circuits of electrical plants, whether used for the distribution of light or power over long or short distances, form at once the most vulnerable portions of an installation because of their exposure to many trying influences, led Mr. Fred. M. Locke, of Victor, New York, to make special inquiry into the manufacture of strictly high grade appliances, such as pins, brake arms, side brackets, cross arms, special glass and porcelain insulators and other fittings used in pole line construction. This being a day of specialists, it cannot but be admitted that Mr. Locke has brought out a quality of line materials that are unsurpassed. The Locke indestructable steel pin is one that stays where you put it. It does not rot or rust, it is practicably impossible to break it, and it costs but $1.60 per mile of line more than wooden pins.

Then there is the Locke triple petticoat China insulator so extensively used in high potential power transmission circuits. A noteworthy example of the use of this insulator in California is in the Nevada county power transmission at Nevada City and Grass Valley. The insulator measures 5¼ inches in diameter, is 4 inches in height, and, having over twelve inches of surface between the wire contact and the supporting pin, and ten inches of which surface is on the under or dry side, it has been found by repeated practical tests to successfully withstand puncture from a potential of 85,000 volts. The body and glaze of these insulators are of simple earths only, fused together into a vitrious homogeneous mass at the greatest heat, and as no lead or other metallic oxide is used in the making, the glaze is not a conductor. The insulators do not craze or crackle on the surface, as insulators made of inferior material do when subjected to variations of temperature, and, in brief, the superior quality of the materials and workmanship used renders the insulators proof against severe tensile strains or heavy blows, against cracking or chipping from the effects of high potentials, and against the actions of heat, cold, dampness, acids, alkalis or other substances or forces. Being the very best it is the cheapest, though yet inexpensive. Triple petticoat glass insulators designed for currents of 5.000 volts or less, together with special transposition insulators used for the purpose of transposing telephone wires to overcome the effects of induction, are also manufactured, as are railway deep-groove double petticoat insulators, and other insulators of all sizes and designs. The accompanying illustration shows a few of the many high-grade pole line specialties brought out by Fred M. Locke, and among which may be enumerated indestructable steel pins, brake arms, side brackets, glass and porcelain insulators, braces and pole fittings for all classes of line work.

CIRCULAR LOOM CONDUIT FOR THE COAST.

Messrs. J. W. Brooks & Co. of San Francisco, having received the general Western Agency of the American Circular Loom Company of Boston, Mass., are introducing flexible "canvas jacket" conduit on the Pacific Coast that is already meeting with marked success. This conduit is not a new departure, but merely an improved appliance for accomplishing a given and approved result. All conduits, or tubes heretofore furnished for this purpose, have been of a rigid type, connected at short intervals by metal sleeves, and with moulded and rigid elbows. By use of flexible conduits these objectionable points are entirely eliminated, and its flexibility allows of bends of any radius at the will of the constructor. Each "run" may be an entire length; its tightness not depending on the nicety of the fittings of a number of joints or of the carefulness of the constructor.

It is constructed of the best insulating fibre, wound with a heavy Para rubber friction tape; over which is a continuous woven jacket of cotton, similar to that in use in the ordinary cotton garden hose, except that the stitch is much finer, giving it the quality of strong canvas. The whole tube is then saturated with an insulating compound, care being taken that none shall touch the inside fibre, thus leaving the inside of the tube smooth and hard. It is finally run through powdered mica, thus producing a tube which is thoroughly flexible and water-proof and which is highly fireproof. The tubes can be furnished in any lengths, but for convenience are shipped in coils of from 250 to 500 feet, according to diameter. Flexible conduit has passed the rigid inspection of the Underwriters' National Electric Association, and will be found specified under their rules and requirements, dated Octoer 2d, 1893, page 15, Rule 22, as "The American Circular Loom Tube."

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THE NANTASKET TROLLEY WIRE.

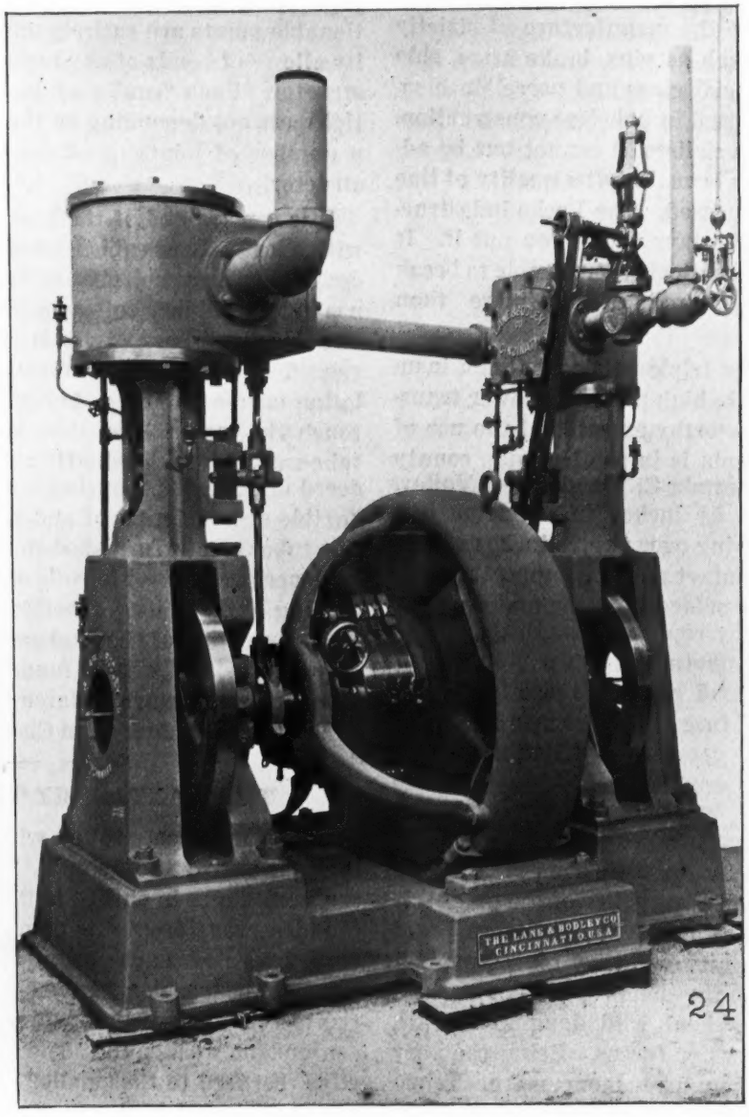
The Nantasket trolley wire, which was recently brought out by the John A. Roeblings' Sons Co. is of the form shown in outline in the accompanying cut, and the idea prevailing in its manufacture was to design a trolley wire of such shape as would afford a ready means of suspension, at the same time dispensing with the use of trolley clips, which occasion sparking and consequent weakening. The wire is suspended from clips secured to the smaller portion of its cross section, which leaves an uninterrupted smooth surface for the trolley wheel to traverse. The heavy amperages necessary to operate the electrically operated standard railway trains on the Nantasket line made it imperative that more perfect contact between the trolley wheel and wire should be secured, which resulted in the designing of the wire here illustrated. This wire has an area of 330,000 circular mils, or the equivalent of a No. 0000 and a No. 0 wire.

A consideration of the area of the Nantasket trolley wire brings up the suggestion that its use is advisable

over that, for instance of a No 0 trolley wire and a No. 0000 feeder, because no money is invested in insulation of feed wires and the same carrying capacity is secured.

A DIRECT CONNECTED OUTFIT.

During the recent Atlanta Exposition the Card Electric Motor & Dynamo Company, of Mansfield, Ohio, exhibited a new type of direct connected engine and dynamo outfit, which elicited universal commendation.



A Direct Connected Card Dynamo Outfit

The equipment, as illustrated in the accompanying engraving, consisted of a type H multipolar Card generator, driven by a cross-compound Lane & Bodley engine, running at a speed of 275 revolutions per minute.

This combination plant made an enviable record during the Atlanta Exposition, where it was in regular service on other light and power circuits. Messrs. J. W. Brooks & Co. of San Francisco, hold the Pacific Coast agency for the Card apparatus.

The Lay Press.

POPULAR REFLECTIONS OF THE CONDITIONS AND PROSPECTS OF ELECTRICAL ENGINEERING ON THE PACIFIC COAST.

The deposit of salt on the telegraph wires through Utah interferes somewhat with the transmission of news, but it lessens the difficulty of taking the news cum grano salis when it does arrive.—San Francisco Examiner.

"Saginaw Jake," the well-known Killsnoo chief, was in town this week, and for the first time saw electric lights. He at once became infatuated with them, and on being told that the little incandescent ones with a good long "string" attached could be purchased for a dollar, he declared that he would decorate his house with them—they were just what he wanted, but he was puzzled to know how to get inside of the globes to light them.—Juneau, Alaska, Mining Record.

The Douglass mill at this place, which has been lying idle for a number of years, has a splendid water power that might be put to some use in the way of furnishing electricity for light and power in this place, Silver City, Gold Hill and Virginia City. An electric plant could be placed in the mill at a comparatively small cost, and it would not be a very expensive scheme to construct a line of wires from here to Virginia City. This town could be lighted by electricity, and so could the other places along up the canyon at a very small expense. Besides lighting the towns, probably quite a number of small power users would take a line to run their machinery. We believe an enterprise of this kind would pay at this time and if the looked-for better times come this year, we are very sure there would be money in the scheme.—Dayton (Nev.) Times.

The Review-Budget calls attention to the fact that one of the best opportunities in the State for obtaining electric power, and in a cheap way, is just at hand and might be used to our great advantage. This opportunity lies in the water of the Mokelumne river. * * * There is an enormous electric plant being constructed on the north bank of the San Joaquin river, and a great deal of capital is being put into it for the purpose of bringing light and power to Fresno City, and the point of location of the plant is thirty-five miles from Fresno. An electric plant of equal force and of as great power could be placed at Westmoreland's bridge, where the old Mokelumne Ditch Company located its dam, and have a fall of several hundred feet, all that would be required under any circumstances to generate the electric current, and this not twenty miles from Lodi, on a direct line. If a plant were put in there it could supply Stockton and all the neighboring towns with just such power and light as is to be furnished Fresno. —Lodi (Cal.) Valley Review.

The great benefits that would result from the operation of an electric railroad from this city to Clear Lake are readily seen and acknowledged by all. But the introduction of the electric power as proposed by the promoters of this enterprise would prove of vastly greater importance to the future industrial prosperity of Napa than the mere benefits that would follow the operation of a railroad system. Electricity is the power of the future, and the community that neglects to secure its introduction when the opportunity offers will throw away all hope of keeping up in the race of progress. Manufacturing industries of all kinds demand cheap power, and are everywhere seeking localities where such power can be obtained. The present project for transmitting electric power from Clear Lake offers Napa an opportunity for advancement that should not be neglected. Our tide water location makes Napa admirably adapted for manufacturing enterprises, and with the introduction of cheap power her future prosperity would be assured. A conservative estimate places the amount of power now in use in this city and immediate vicinity at 500 horse-power, at a cost of $6 per month for each horse-power—a total of $3,000 per month, or $36,000 a year. Should the project of transmitting electric power from Clear Lake be carried to a successful issue, power can be furnished to these same industries at a rate not to exceed $3 per horse-power per month, a saving of just one-half the present expense. In other words, the advent of electric power would prove a direct saving to the industries at present established in Napa of $18,000 a year, or in ten years the enormous sum of $180,000. Will Napa embrace the opportunity offered by the promoters of this electric project?—Napa (Cal.) Journal.

From present indications it is highly probable that the motive power that will be used in the development of California's manufacturing enterprises in the near future will be electricity. Slowly the electric current is being utilized in place of steam power and the incandescent lamp is supplanting gas. The unparalleled rapidity with which electricity has forced its way into public favor as a motor in industrial enterprises has been productive of a great number of new inventions in machinery and mechanical appliances. This in turn has brought about the establishment of numerous factories for the manufacture of such goods and the creation of mercantile houses for their introduction and sale. New industries are being constantly looked for on the Pacific Coast, which has always been to a considerable extent dependent upon the importation of manufactured goods. In this connection a late discovery is a process of smelting iron by electricity. It is a well known fact that there are immense deposits of mineral in the northern part of the State, where the mountains are rich in iron ore. This could, by Edison's latest process, be converted into a very valuable product. In the immediate vicinity of the ore bodies water power is abundant, the combination forming all that is necessary for the establishment of extensive smelting works. With such a constant and increasing demand as exists on this side of the continent for pig-iron, structural iron and steel, these facts should offer sufficient inducements to enterprising capital if the electric process is as successful in practice as it is in the laboratory.

San Francisco is well up with the spirit of the age, as far as mechanical improvements are concerned. There are numerous manufactories of electric motors and other appliances, besides a number of establishments where the smaller devices and mechanisms of electric science are made and sold. The discovery that a dynamo could be made a motor is scarcely more than a dozen years old, though during that interval such magnificent and wonderful results have been attained as rival those ever achieved in any branch of mechanical art. In this State one of the principal applications of the transmission of power to long distances will no doubt be in the working of mines which have been for a long time past idle owing to the great cost of the necessary power as obtainable by steam. Many of such mines are at a considerable distance from water, but that can now be overcome. The power can be developed at the water supply and transmitted by wire to the plant at the mine or mill, and there be used for any purpose for which steam is available.

As a means of propulsion for street cars electricity is conceded to be not only in all respects the best, but the most economical motive power thus far devised. The enormous power station which furnishes the current for the electric car lines of this city is fitted up with all the latest and most approved machinery that fully meets the requirements demanded of it. Almost all the machinery in this great plant was manufactured in this city. The electric light is coming into general use, and all modern residences are wired for incandescent lighting. The interior cities of the State have not been slow in appreciating the advantages and comparative cheapness of electric light plants as compared with the older methods, and there are few exceptions among the towns of any size where electric light plants have not been established, and in almost all instances the investments have proved profitable to the parties interested.—San Francisco Chronicle.

A company has been formed with a capital stock of $500,000 to erect and put in operation an electric power plant at Horseshoe Bend, Mariposa county. It is announced that power will be generated and transmitted to any reasonable distance, and furnished at a cost of $5 per month per horse power. Thus a small quartz mill requiring ten-horse power could be operated at an expense for power of $50 per month, a less sum than would be paid in wages alone for a steam engine. Then the fuel for a steam engine would cost probably $150 per month. The mine owner would have no engine and boiler to purchase, nothing but his mining machinery. The electric power will permit of the opening of hundreds of ledges in that region which are owned by poor men, and who could not afford to purchase expensive steam appliances. A man can set up a stamp battery and commence working his claim with very little cost. If the ledge did not pay he would not be out any considerable sum. The electrical power proposition is one of the longest strides yet made toward working the hundreds of low grade ledges known to exist to the east and south of us in the Sierra Nevada mountains. The matter is one of vast importance to Stockton. The founderies and other manufactories here are prepared to turn out any and every kind of mining machinery at the lowest possible cost, while the shipping facilities of Stockton are first class.

Reports of the Month.

COMMUNICATION

Astoria, Oregon.—The eight box municipal fire alarm system has been completed.

San Francisco, Cal.—W. J. Martin has been appointed Manager of the San Francisco office of the Western Union Telegraph Co., vice John McRobie, resigned.

Los Angeles, Cal.—The Pacific Coast Telephone and Electric Motor Co., a recent incorporation, proposes to manufacture telephones, under the patents of Frank H. Brown.

Gray's Harbor, Wash.—The Federal Government is to be petitioned by the maritime interests of the Coast to construct a telegraph line from Tatoosh Island south to Gray's Harbor.

Tucson, Ariz.—Chas. F. Hoff of this city proposes to establish about 30 miles of telephone line running from Prescott to Chapparel, to the McCabe mine, to Massic's hydraulics and to Wagnerville. He will also endeavor to connect Phoenix and Prescott, and later to extend the line to make it continuous from Nogales to Flagstaff.

San Jose, Cal.—Messrs. Minor & Chute have erected a line of 55 foot poles on First street for the new telephone company, and are hastening the completion of their contract calling for ——The new telegraph and telephone company has leased the second floor of the Archer building, No. 13 South First street, to be used as the local exchange.

Stockton, Cal.—The Gamewell Fire Alarm and Telegraph Co. through R. A. Rose, Pacific Coast agent, has secured the contract for increasing the efficiency of the fire alarm and police telegraph system in Stockton, which amounts to the practical reconstruction of the entire system.——Work on the telegraph line of the San Joaquin Valley Railroad Co. is being pushed and the poles and wires are up now to a point beyond Burnham.

INCORPORATION.

Redwood City, Cal.—The Redwood Electric Light Co. Directors: J. Geo. Gardner, P. P. Chamberlain, Alex. Gordon, Edward F. Fitzpatrick and Jas. Crowe.

San Francisco.—The Abbott Electric Air Cooling and Purifying Company. Directors: H. W. Abbott, D. Gilbert Depter, A. S. Brackett, Mark Strouse and H. C. Birbee. Capital $1,000,000.

The California Natural Gas, Oil and Land Co. To develop petroleum deposits at Half Moon Bay. Capital stock $1,000,000. Directors: C. F. Sterrett, L. L. James, J. B. McGlew, E. J. Bean and F. M. Smith.

Fresno, Cal.—The Kings River Power Co. Capital stock $300,000, in 3,600 shares of $100 each, of which 1,500 shares have been subscribed by the following Board of Directors: S. F. Earl and the erection of telephone poles throughout the business section. J S. Jones of Reedly; Jas. Sibley of Dinuba; and W. H. Hammond and Chas. G. Wilcox of Visalia.

San Francisco.—The Mill Valley & Mount Tamalpais Scenic Railway. Not only to build and operate a railway, but also to erect and construct hotels and refreshment houses; operate telegraph and telephone lines, etc., in Marin county, Cal. The road will be eight miles long. The stockholders are: Tamalpais Land and Water Company, A. E. Kent, S. B. Cushing, Arthur A. Martin, William MacCann, M. M. O'Shaughnessy, William C. Savage, Cornelius Toohy, W. C. B. de Fremery, David McKay and Charles C. Green. The capital stock is $200,000, of which $45,600 has been subscribed.——The Gerlach Wave Motor Development Company. Board of Directors: M. A. Rothschild, Pres.; Fred Hilbert, Vice Pres.; M. Feintuch, Sec'y and Treas.; B. D. Pike, E. Gerlach, Manager.

LITIGATION.

Tacoma, Wash.—The city of Tacoma has been awarded a verdict of 787,500 damages against the Tacoma Light & Water Co. for alleged misrepresentation and fraud resulting in the city's purchase of the water and electric light plants in 1893 for $1,750,000.

Santa Cruz, Cal.—Difficulties regarding the management of the Santa Cruz Electric Light & Power Co. have resulted in the bringing of several actions in the Court of various natures, among which may be named a suit to cause the removal of a director, to recover commission for services rendered, and to determine the legality of certain stock issued.

San Diego, Cal.—Isabella K. Stafford has sued the Western Union Telegraph Co. for $11,000 damages for the alleged non-delivery of a telegram. Complainant alleges that owing to the neglect of the company to deliver a telegram announcing the arrival of her mother, who was ill, and requesting Edward F. Kimball to meet them at the depot, in searching for the residence of said Kimball the mother was exposed to cold and inclement weather, from the effects of which she died.

San Francisco, Cal.—Judge Seawell has rendered a decision in effect that the Sunnyside Construction Co. was the accredited agent of the San Francisco and San Mateo Railroad Co.,

and the acts of the former were directed by the latter and consequently legal. The Court sustained the validity of the bonds issued, and ordered that as soon as a final decree should be signed the railroad should be sold and the proceeds applied to defray the costs of the suit, to pay the expenses of the receiver, and to liquidate preferred claims. By this decision the eight miles of double track electric road extending from Market and Steuart streets into San Mateo county passes from the hands of the Joosts. The case will probably be appealed to the Supreme Court.

TRANSMISSION.

Los Angeles, Cal.—The Kern River & Los Angeles Electric Power Co. has accepted an ordinance granting it the right to build and operate transmission circuits along prescribed routes in the county.

Spokane, Wash.—Wm. Nelson states that within 90 days work will begin on the construction of a new flour mill containing a plant for furnishing electric power, together with a smelter and reducing works.

City of Mexico, Mex.—Mr. J. Sternfield has placed orders in San Francisco for a Girard water wheel and a 100 kw. Westinghouse 2-phase generator, to be direct coupled and used for mining transmission purposes.

Santa Cruz, Cal.—The Big Creek Electric Power & Water Co. have given the contract for 300,000 feet of logs for building the proposed transmission plant to Logan, Thurber & Makinney, the contract to be completed by July 25th.

Mariposa, Cal.—The Board of Supervisors has adopted resolutions of congratulation to H. H. Clark of the Bend Power Company for his enterprise in developing and promoting the transmission project of the Bend Power Co.

Salt Lake City, Utah.—The power house of the Big Cottonwood Power Co. at the mouth of Big Cottonwood Canyon, is finished and machinery foundations are being erected. Fourteen miles of 60-foot cedar poles from Sand Point, Idaho, have been erected and linemen are now stringing the 12 wires constituting the circuit from the power house to this city.

Bakersfield, Cal.—The Supervisors of Kern Co. have given permission to the Kern River & Los Angeles Electric Power Co. to erect transmission circuits over the highways of the county.——The plans of the Power Development Co. are now matured, all money necessary has been secured, and specifications have been isued for the building of the plant. Chas. N. Beal is Manager.

San Bernardino, Cal.—The Board of Trustees have inspected the site of the proposed electric power house on Lytle Creek, 16 miles distant, and if the proposed plant can be installed at a reasonable expense, it is probable that the question of issuing bonds for a municipal lighting plant will be placed before the people at a special election at an early date. J. C. Christy, one of the owners of the water right, appears foremost in the transaction.

Sacramento, Cal.—A Tesla 5 horse-power motor has been installed in F. H. Veach's machine shop.——Dr. Van Norden, representing the Central California Electric Co., principally owned by the South Yuba Water Co., has stated to the Board of Trustees that the company has expended over $25,000 on its transmission circuits which were rapidly approaching Sacramento. The length of transmission is 29 miles, and pole line circuits would only be continued to the lettered streets of the city, all other distribution being through underground conduit.

Auburn, Cal.—Walter S. Davis is to take power from the north fork of the American River, seven miles distant, and will operate thereby a 26 inch Girard water wheel to run under a 400 foot head. This wheel, which has a capacity of 300 horse power, will be directly connected to a 150 horse power Electrical Engineering Co.'s D. C. dynamo, whence the power will be transmitted to the Davis mining properties three-quarters of a mile distant, and will be used for various purposes, including the operating of centrifugal pumps and hoists. The order for the machinery has been given to the Girard Water Wheel Co. and the Electrical Engineering Co. of San Francisco.

Visalia, Cal.—The Kings River Power Co. propose to build a power ditch four miles in length to divert water out of Kings River above Mill Creek, by means of which 3,000 horse power can be developed, at a head of 541 feet in the first mile of ditch. It is proposed to transmit electric power to Sanger, a distance of 11 miles, and to Fresno, 26 miles. It is reported that Jesse Grant of San Diego, the son of General Grant, is interested in the project. One of the chief enterprises contemplated by the company is pumping water for irrigating lands near the hills too elevated to be reached by gravity canals. Among other towns named as probable markets for power are Reedly, 12 miles distant, Selma, 22 miles, Fowler, 22 miles, Kingsburg, 21 miles, Traver, 23 miles, Dinuba, 18 miles, and Visalia, 28 miles.

ILLUMINATION.

South Bend, Wash.—Electric lights are to be put in the South Bend saw mill.

Ferndale, Cal.—Nelson & Kerri are in the market for 100 32-foot electric light poles.

Santa Monica, Cal.—The Board of Trustees has advertised for bids for a gas franchise.

Chehalis, Wash.—Ole Rung has been appointed City Electrician, vice Geo. Baldwin, resigned.

Stella, Wash.—Gus Herring will probably erect an arc lighting plant, to be run by water power.

Woodland, Cal.—The electric plant of the Woodland Gas & Electric Light Co. will soon be enlarged.

Orland, Cal.—The Board of Supervisors are to consider plans for a gas lighting plant for the Court House.

Sonora, Cal.—Eugene D. N. Lehe, of Stockton, is installing an incandescent plant in the Rawhide mine.

Junction City, Or.—Robert Clow and associates have been granted a 30 year franchise for an electric light plant.

Nevada City, Cal.—The Nevada County Electric Power Company is installing 10 constant potential Upton arc lamps.

Pomona, Cal.—The San Antonio Electric Light & Power Co. has secured the annual contract for municipal arc lighting.

Butte, Mont.—The Castner Coal and Coke Company is drafting plans for a $22,000 electric light plant, to be erected at Belt.

Redwood City, Cal.—J. Geo. Gardner has purchased an additional 60-kilowatt alternator for the Redwood Electric Light Co.

St. Helena, Cal.—The Gas Company has built an extension to its gas house, in which is being installed a Van Sickle gas generator.

Oakland, Cal.—D. E. Martin has been elected President of the Oakland Gas Light & Heat Co., succeeding the late John W. Coleman.

Grass Valley, Cal.—John Glasson has increased his electric light plant by the addition of a 175 kilowatt Westinghouse alternator.

San Francisco, Cal.—An incandescent lighting plant costing $2,960 is being installed on the revenue cutter "Rush" by the General Electric Co.

La Grande, Or.—Geo. Mayer of Portland has finished the installation of an arc lighting plant for the Grande Ronde Placer Mining Co.

Morenei, Ariz.—L. C. Trent & Co. of Salt Lake City have secured the contract for an electric light and power plant for Wm. Church's mine.

Colusa, Cal.—The proposition of bonding the town to buy or build its own water works and electric light plant is meeting with general favor.

Santa Barbara, Cal.—The Santa Barbara Gas Co. has already expended over $50,000 in the construction of its new gas plant, now nearly completed.

Santa Monica, Cal.—The new Siemens-Halske plant at the Soldiers' Home is now in operation, and the use of 220-volt incandescent lamps is a success.

Haywards, Cal.—Lightning struck the plant of the Haywards Electric Light Co. on January 25th, burning out the dynamos and throwing the city in darkness.

San Leandro, Cal.—The Board of Trustees will receive bids until February 4th for the construction of the electric light plant, for which $10,000 has been voted.

Santa Monica, Cal.—The Santa Monica Electric & Power Co. has erected a new 150 horse power boiler, engine and incandescent dynamo. J. J. Davis is Manager.

Los Gatos, Cal.—It is understood that F. G. Hume of Glen Una ranch, will endeavor to secure the contract for city lighting, and if he does will erect an electric light station.

Colfax, Wash.—The Colfax Electric Light & Power Co., by W. J. Hamilton, President, proposes to light the city with arc lamps for $12 per month per lamp for all night lighting.

Pasadena, Cal.—The San Francisco office of the Fort Wayne Electric Corporation has sold a 1,000 light Wood alternator, equipped complete, including transformers, to E. C. Wright.

Nevada City, Cal.—K. Casper is grading a lot on Commercial street preparatory to the erection of his new electric light plant. The station will be run by water power from the Yuba flume.

Roslyn, Wash.—An interest in the electric light plant has been sold for taxes to Ellensburgh parties, who will probably acquire the remaining portion and start up the plant in the spring.

Canyon City, Or.—An electric light plant for this city and for the town of John Day, two miles distant, is talked of, and if installed, the Humboldt Placer mine will be a consumer during the mining season.

Santa Cruz, Cal.—Clarence E. Lane has resigned the electricianship of the Santa Cruz Electric Light & Power Co., and will hereafter be associated with F. W. Swanton's transmission projects in a similar capacity.

Salt Lake City, Utah.—O. B. Hardy has turned over his electric franchise for Bingham to the Salt Lake & Ogden Gas & Electric Light Co., which will at once string wires from this place to Bingham and light the town.

Riverside, Cal.—Bids on the amended specifications for the municipal lighting plant have been received from the California Electrical Works of San Francisco for $40,978, and from the General Electric Co. for $39,750. Action deferred.

Alameda, Cal.—The City Electrician has prepared specifications calling for bids for one 250 kw. 2,200 volt A. C. dynamo of 7,200 alternations per minute, together with full switchboard equipment. New engines and boilers are also required.

San Mateo, Cal.—The San Mateo Electric Light Co. has been granted permission to erect poles and wires along the county road north to Millbrae, and south to Belmont. A similar privilege has been granted to J. Geo. Gardner of the Redwood Electric Light Co.

Auburn, Cal.—The California Interior Development Co. has purchased a 12-inch Alcott turbine to run under 24 foot head from the Electrical Engineering Co., agents, San Francisco. This turbine will operate a Thomson-Houston arc dynamo for mine lighting.

San Francisco.—An additional 80-light Wood arc dynamo, together with 35 lamps, has been sold to the Mutual Electric Light Co.———The arc lighting of the new Parrott building will be accomplished by 100 Manhattan and about 300 general incandescent arc lamps, all on constant potential circuits.

Spokane, Wash.—Four pairs of horizontal shaft Leffel wheels have been purchased for the Citizens' Electric Light Co., each of which pairs will connect direct to 550 horse power generators.——Idaho Falls is to vote on the proposition to issue bonds for $30,000 for the purchase or erection of water works and an electric light system.

Seattle, Wash.—The Seattle Electric and Gas Fixture Co. is installing a 20 horse power 500-volt generator in the University of Washington, which has also purchased one 2 horse power multipolar 500-volt motor, and one 2 horse power multipolar 125-volt generator for use in its Electrical Engineering Department, all being of Westinghouse manufacture.

City of Mexico, Mex.—The eight year franchise of the Mexico Gas & Electric Light Co. expires on May 8th next, when the corporation, under the terms of the contract, is entitled to buy the plant. The city government has requested S. B. Knight, Manager, to render an estimate of the value of the plant by February 1st, which seems to lend probability to the belief that public lighting will become a regular municipal service.

Dillon, Mont.—The new plant of the Dillon Electric Light Co. is now in operation. The power house is 1½ miles distant, where water power is available, from which is operated a 45 kw. 2-phase Westinghouse generator, delivering current at 1,100

volts, for operating arc and incandescent lamps and delivering power in Dillon. The plant is owned by Mathew Orr, and the entire installation was made by the Montana Electric Co. of Butte City.

Anaconda, Mont.—The Anaconda Co. has ordered Leffel turbine wheels to operate two new dynamos that are to be installed in its electric plant.

Riverside, Cal.—C. B. Hughes and associates have filed a water claim for a continuous flow of 1,500 inches of water at Miller's Narrows on Lytle Creek, where a head of 700 feet can be developed for electric transmission purposes.

Guadalajara, Mexico.—Manuel and Miguel Quevedo have secured a concession for the exclusive right to use the water power of the Rio Grande de Santiago falls for two kilometers below the bridge Tolotlan for the development and transmission of electric power to this city and neighboring towns.

Vancouver, B. C.—The Western Electric Light & Heat Co. have ordered 16,000 poles for their new plant. The power house will be built on False Creek, and local distribution will be effected at 2,200 volts A. C., interior circuits being operated at 50 volts.

Berkeley, Cal.—The Berkeley Electric Lighting Co. has secured the contract for constructing the lighting and power circuits of the State University grounds.——The Oakland Gas Light and Heat Co. has secured control of the Berkeley Electric Light Co., which has been reorganized with J. A. Britton as President. It is understood that the two companies will not be affiliated, however, and that the Berkeley corporation will continue to operate its own plant.

Stockton, Cal.—The City Council has adopted a resolution of intention to advertise for bids for lighting this city by electricity, in the following manner: First—For lighting the city, the bidder to furnish all poles, dynamos, lamps, and all machinery, etc., necessary for the proper lighting of the city. Second—For lighting the city as specified, the bidder to furnish everything necessary for the proper lighting of the city, with the exception of the poles, which the city will furnish and place.

Napa, Cal.—Officers of the Napa City Gas Light & Heat Co. have been elected as follows: Geo. E. Goodman, President; H. P. Goodman, Secretary; J. H. Goodman & Co.'s Bank, Treasurer; and T. R. Parker, Manager.——The Napa Thomson-Houston Light Co., owned by the General Electric Co., has recently been enlarged by a 200 horse power Ball cross-compound engine, and 150 horse power in boilers. The company at present operates 40 street and 16 commercial arcs and 700 incandescent lamps. H. E. Brandt is Superintendent.

San Francisco, Cal.—The San Francisco Gaslight Company, at its annual meeting re-elected the old directors, as follows: Joseph B. Crockett, Adam Grant, Geo. W. Prescott, Levi Strauss, A. H. Payson, Daniel T. Murphy, J. Downey Harvey. The financial statement showed gross assets amounting to $8,729,501.81, and total liabilities of $144,341.23, making total net assets of $8,585,160.58. The number of consumers increased 671 during the past year, and there was an increase of 50 per cent in the number of gas stoves and engines put in use. The Company will probably move its offices from First and Howard streets to the old Young Men's Christian Association building on Sutter street.——J. W. Brooks & Co. report that universal incandescent lamps are to be used throughout the San Francisco Safe Deposit building.

The Ryder street railway car, operated by compressed air, has been under test at the foot of Lombard street.

San Jose, Cal.—Geo. Werner Hoffman, Chief Electrician of the Electric Improvement Co. was killed by electricity on January 11th. Two 60 light arc machines had been coupled together by Hoffman and operated in series, and in doing this an extension of switchboard circuits was made by coupling two wires together by means of an ordinary brass screw connector, which lay on the floor in front of the switchboard, untaped and unprotected in any way. In starting up the machine Hoffman completed a circuit from a plug in his hand to the bare connector with his shoe, and was instantly stricken. Extraordinary to relate, unconsciousness did not instantly follow, as the testimony of Geo. Johnson, the oiler, at the inquest, shows that conversation ensued between he and Hoffman after the latter received the shock.

Los Angeles, Cal.—The California Electrical Works of San Francisco has secured the contract for wiring the Wilcox building.——E. E. Peck has petitioned the Mayor and Council to advertise for sale an electric light, power and heating franchise in that portion of the city south of Seventh street and west of Main street.——L. B. Pemberton, Consulting Electrical Engineer, has prepared plans and specifications for an isolated arc and incandescent lighting plant for the Los Angeles Ice & Cold Storage Works.——The Los Angeles Edison Light & Power Co. is to install a plant as the General Electric licensees in this city. The plant will have the capacity of 30,000 incandescent and 500 arcs, and will cost approximately $500,000. Chas. R. Lloyd of San Francisco is at the head of the company, which has bought the Lester F. Scott franchise. Work will be commenced within thirty days.

San Bernardino, Cal.—The following bids have been received for 60 or more 2,000 c. p. arc lamps for lighting the city during the ensuing year: San Bernardino Electric Co., $5.90 per lamp per month; Electric Light and Power Co., $7 per lamp per month; San Antonio Electric Light and Power Co., $6.51 per lamp per month. Contract was awarded to the first named——It is announced that Chas. R. Lloyd, President of the San Bernardino Electric Light Co., has succeeded in purchasing the entire plant of the Electric Light & Power Co., excluding only the gas works. This includes the electric station in this city and at East Riverside. Inasmuch as the San Bernardino Electric Light Co. is at present utilizing all the power that can be developed from the irrigation ditch at Kehl's mill, it is possible that the additional power necessary will be secured from the Redlands Light & Power Co.

TRANSPORTATION.

San Jose, Cal.—Popp & Hogan have installed a 500 volt Westinghouse motor.

San Bernardino, Cal.—The horse car system will probably be equipped as an electric line in the spring.

Sacramento, Cal.—The Sacramento, Fair Oaks and Orangevale Railway Company has secured the franchise for which it applied.

Helena, Mont.—D. B. May, formerly of Billings, is endeavoring to secure a franchise for an electric road in Yellowstone National Park.

Tacoma, Wash.—The Tacoma Railway and Motor Co. is hauling its wood trains by 100 horse power electric locomotive, consisting of a box car equipped with four two-horse power motors.

Ventura, Cal.—Nothing will be done towards building an electric railway between Ventura and Santa Paula until the Ojai Valley railroad scheme is assured. E. S. Thatcher is chairman of the Citizens' Committee having the matter in charge.

Monte Cristo, Wash.—Thos. Imeson, of Seattle, is installing considerable electric mining apparatus in the Monte Cristo mines. The transmission circuits for the Burleigh Rock Drill in the Pride of the Mountain mine are finished, and the electric drills will soon be in operation.

Anaconda, Mont.—The Anaconda Electric Railway & Power Co. is installing five Leffel turbines of 800 horse power to run under a 140 foot head. These turbines are coupled direct to the generators, and one is a triple cascade wheel, each wheel having three nozzles.

Berkeley, Cal.—It is reported that the Oakland Consolidated Street Railway Co. will extend its lines to North and West Berkeley in the spring. The route to North Berkeley will probably be up Oxford street and down Milvia street, while the road to West Berkeley will undoubtedly be along University avenue.

Napa, Cal.—The franchise for an electric railroad through the Napa Valley, granted to L. Grothwell last June has been cancelled because of failure to file a satisfactory bond.——Mass meetings are being held in behalf of the proposition of transmitting power here from Clear Lake, for street railway and other purposes.

Elmhurst, Cal.—The Oakland, San Leandro & Haywards Electric Railway is double-tracking the country divisions of its lines. Fifty-six lbs. English T rails are being used and the overhead equipment is being altered from bracket to span wire suspension.——Experiments are being made at the O. S. L. & H. Electric power-house in the way of increasing the draught by blowing jets of steam through the coals from beneath the grates.

San Jose, Cal.—The total subscriptions to the proposed electric railway from San Jose to Saratoga now amount to $15,000. The Board of Trade has requested L. M. Hale, the local representative of an Eastern syndicate, to petition the Board of Supervisors for the necessary franchise at once. It is hoped that the new line will be in operation during the Rose Carnival in May. Mr. Hale has renewed the proposition to build the road for $200,000, provided $50,000 is subscribed locally.

Los Angeles, Cal.—Francisca A. Jeresun has applied for an electric railway franchise over Fifth and Main streets.——During February The Los Angeles Con. Street Railway Co. will have all its lines operated by electricity.——The Board of Supervisors will receive bids on February 10th for an electric railway franchise for 50 years from Los Angeles to Santa Monica, on petition of E. P. Clark.——The Main Street and Agricultural Park Railway has been sold to the Los Angeles Electric Railway Co.

Oakland, Cal.—The Piedmont & Mountain View Railway Co. has converted seven cable cars into double end electric cars, each having two 40 horse power equipments in addition to the usual cable grip and track brakes. These cars have been run experimentally over the Piedmont Hills division of the road, which has just been equipped with electricity, the maximum grade of which is 14.5 per cent. The heaviest travel is on Sundays, when both the cable and electric systems will operate on the same route, but on week days the trolley alone will be used. ——Certain Oakland capitalists have inaugurated a movement to build an electric road from Lower Lake to Vineyard, 12 miles from Napa. W. H. McKinnon of Oakland and Richard Wylie of Napa are prominent in the scheme. It is proposed to develop power on Cache Creek, Lake county, where 7,500 horse power is available.

Portland, Or.—The Portland General Electric Co. has acquired control of the Union Power Company, which until the present time has been supplying power for all the street railway systems in the city except the lines of the City and Suburban Company. The Union power plant has a capacity of 1,400 horse power, and in all probability it will be supplanted by the use of power transmitted from Oregon City.——The projectors of the First Street Electric Railway contemplate extending the line south from Jefferson street to Grant street, a distance of ten blocks.

Truckee, Cal.—D. B. and C. T. Bliss of Nevada, intend to build a broad-gauge electric road over the Sierras from Truckee to Lake Tahoe, a distance of 16 miles, at a cost of $100,000. Power will be obtained from the outlet of the lake, and it is expected that the line will be finished by June 1st. Elaborate improvements intending to enhance the attractiveness of Lake Tahoe are also being carried out by these parties, prominent among which is the building of a steel passenger steamer costing $70,000. This craft, which is now being built by the Union Iron Works, will have a speed of 23½ knots per hour, and will be fitted with all modern equipments, including electric lights.

San Francisco, Cal.—The Mission street line of the Market Street Railway Co. will soon be extended out Mission road to the county line and also across Sickles avenue to the S. P. depot in Oceanview.——Trial trips have been made over the Sutro road, and its formal opening occurred February 1st. The line starts at the intersection of Central avenue and Geary street, running out Central avenue to California, to Williamson, to Richmond avenue, to First avenue, to Clement street, to 33d avenue, to Point Lobos avenue and Point Lobos road, to 48th avenue, and winding down thence to the Sutro baths near the beach.——The surveys for the Mill Valley and Mt. Tamalpais Scenic Railway have been completed, and plans for the equipment, including the power house, have been prepared by Messrs. W. Stuart-Smith and Sidney Sprout, Consulting and Supervising Electrical Engineers. The power house will be located in Mill Valley, whence the road will continue through Blythdale, then up on the mountain at a maximum gradient of 7½ per cent. Ground on the line will be broken on February 3d. The original intention to construct a cog or cable road has been abandoned and the trolley system alone will be used.

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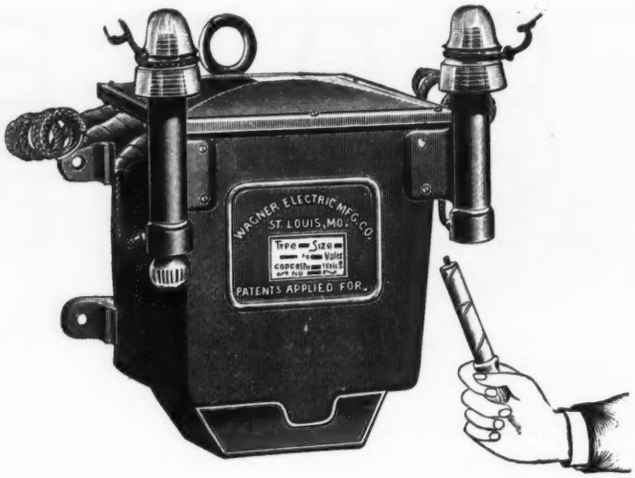

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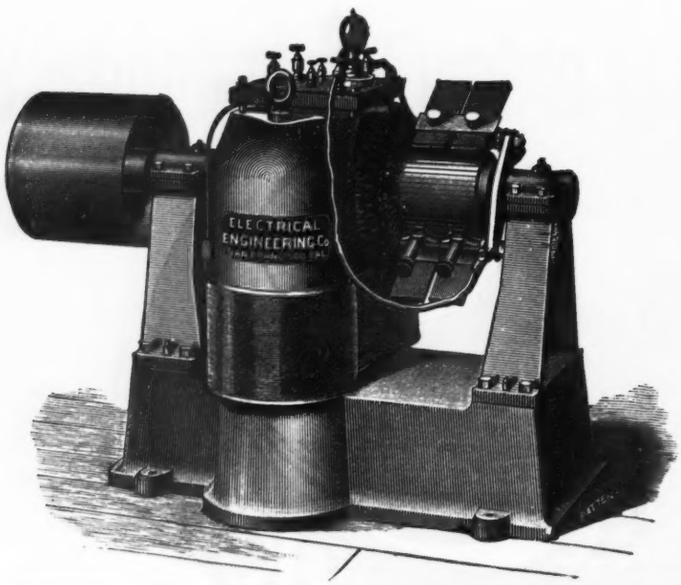

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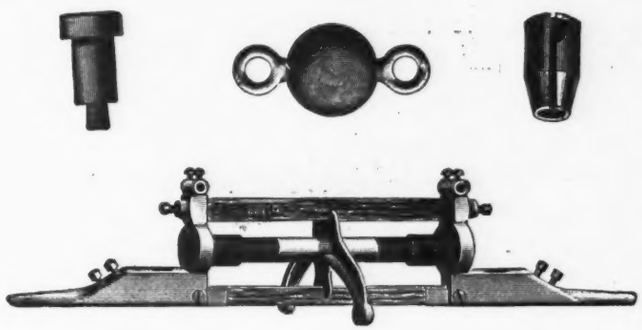

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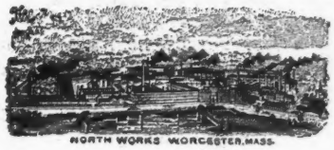
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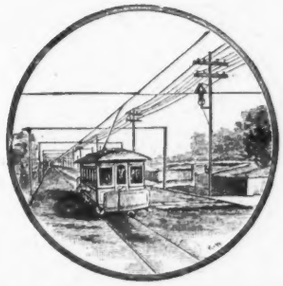

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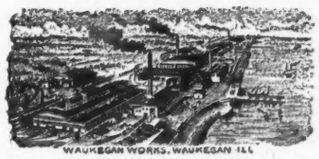
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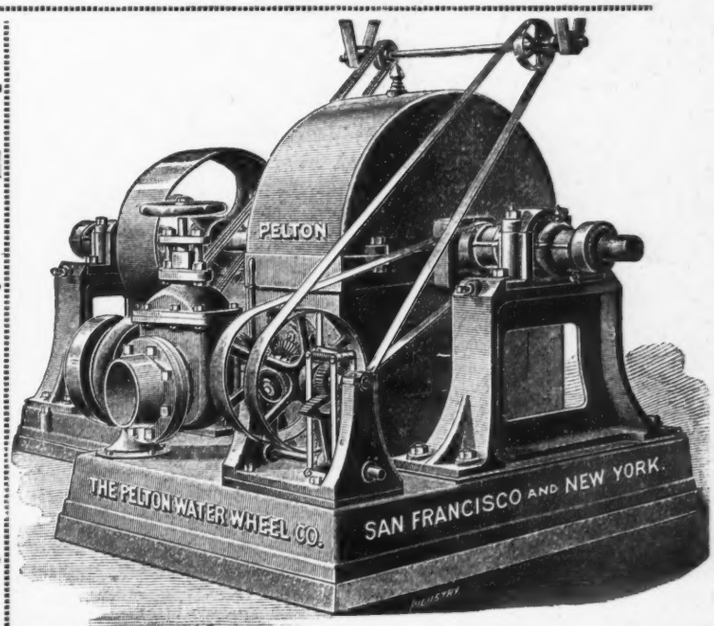

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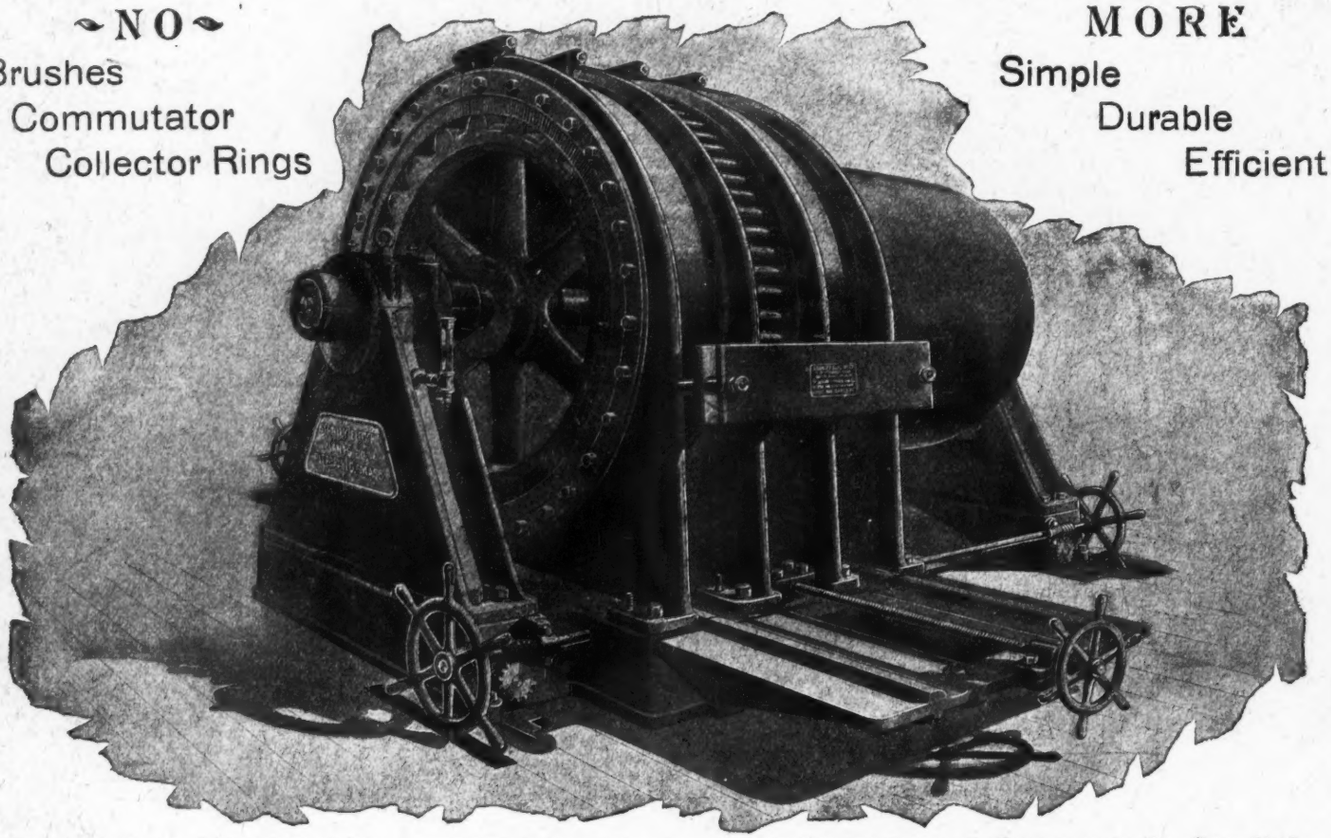

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